VOL. 30, NO. 1 JANUARY, 1953

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Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

ANNUAL SUBSCRIPTION, UNITED STATES and CANADA $6.00. FOREIGN $6.50
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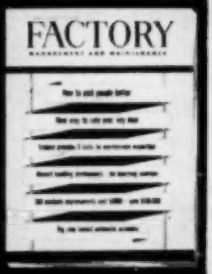


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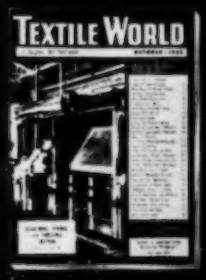


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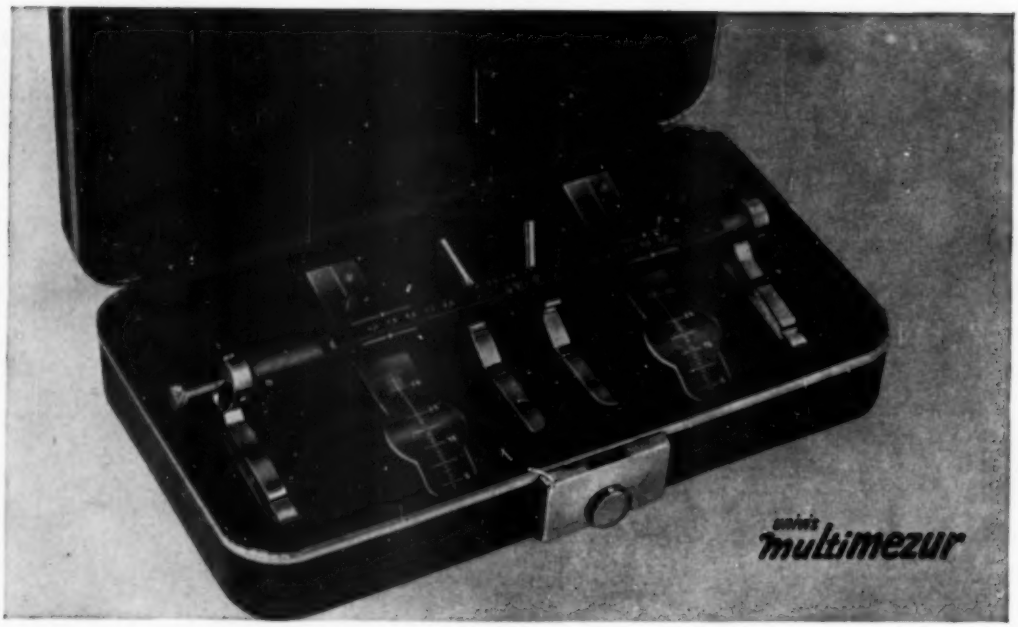


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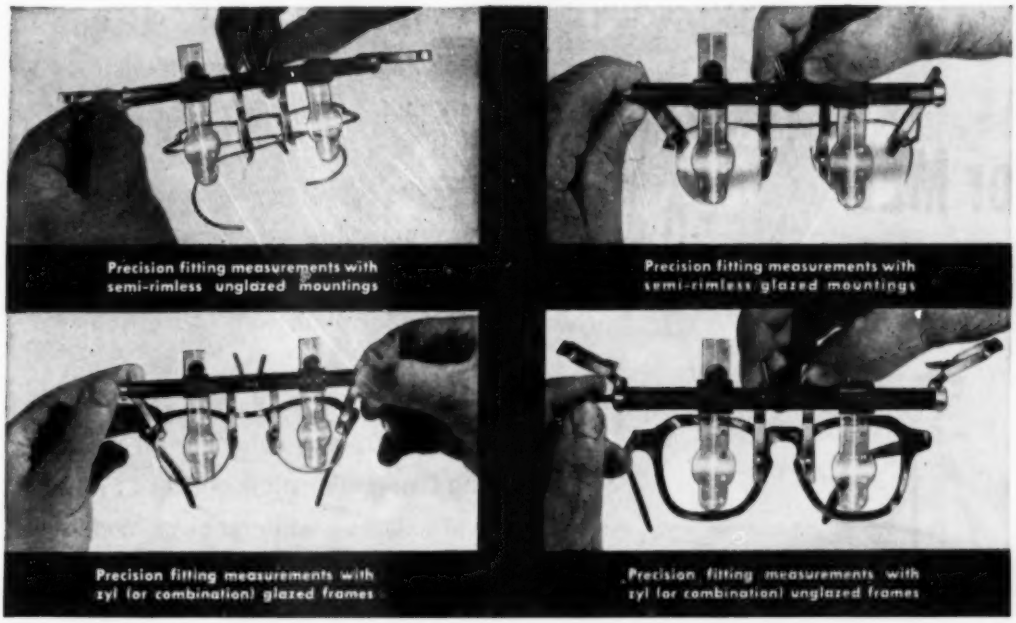
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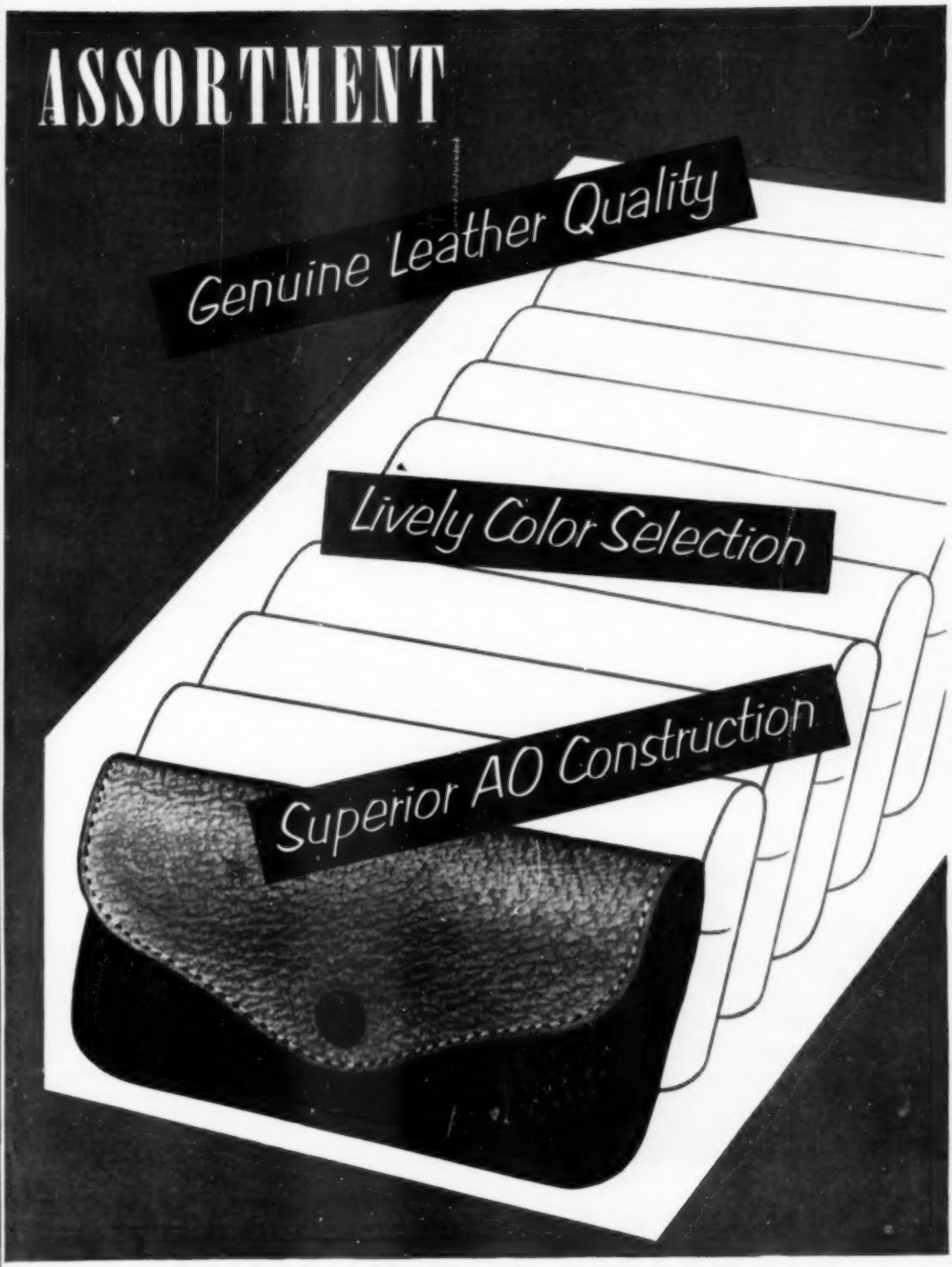
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# THE RELATIONSHIP BETWEEN VISUAL TRAINING AND READING AND ACADEMIC IMPROVEMENT*

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## INTRODUCTION

Visual training has been employed professionally and experimentally by optometrists and ophthalmologists, and experimentally by psychologists and educators, over the past 15 years. Generally, it is looked upon as a technique for improving visual skills. The basic assumption in such training is that the seeing process is a *learned* skill and therefore is amenable to improvement through proper development of the functions involved, reorganization of the visual skills pattern, and, in certain cases, subjecting the individual to visual phenomena never before experienced.

Lancaster[3] and Lundvisk[4] have suggested that improvement in vision is accomplished by providing a fund of experience to aid in the interpretation of sensory impressions, while Burri[2] and Pascal[6] feel that increased fusion ability may account for improved seeing ability in many instances. Renshaw's studies[8] suggest that tachistoscopic training increases the size of the visual form field resulting in a greater range and greater speed of visual perception which is reflected in faster and more economical reading.

The consensus seems to be that visual training should be considered as a process for improving the innervation at synaptic and neuro-

*Submitted on July 28, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
This study has been made possible through a research grant to the Department of Psychology by The North Carolina Optometric Society.
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§Ph.D. Member of faculty.

muscular junctions and for providing a new fund of information by which one may better interpret his visual impressions.

Previous reports of visual training studies are not conclusive as to results achieved. In general, there is insufficient evidence of lasting improvement in speed of fixation, pursuit, or motility. While this improvement may be only temporary, improved ability in other visual functions and greater visual comfort do seem to persist. The ability to read faster, as well as the ability to read with greater comprehension, appears to be one of the skills more amenable to permanent improvement.

The need for adequate motivation of visual training subjects has been indicated by Apperson,[1] Peters,[7] Woods,[9] Woolf,[10] and Worcester.[11] Visual training studies frequently have been criticized because of lack of control from the standpoint of motivation of the subjects. Because visual training must be conducted individually or with small groups, the element of attention given the subject may be of considerable importance. The subject's feeling of confidence and accomplishment might, in itself, have a salutary effect upon the outcome of training regardless of the kind of training being given.

This study was designed to avoid criticism concerning heightened individual motivation resulting from the experimental situation. A group receiving only counseling was introduced as a sort of second "control" group, one in which it was hoped that the subject's interest and motivation would be sustained at a level equal to that of subjects actually receiving visual training.

PROBLEM

The problem was to determine the effect of visual training upon the visual characteristics and reading ability of college students and its effect upon their academic performance and personal adjustment patterns.

SUBJECTS

Principally sophomore students in agriculture and education curricula were used as subjects. Participation was on a voluntary basis. A letter from the student's dean advised him of the nature of the proposed study and urged his participation if he could spare the time. Nearly all of the original 65 subjects were having academic difficulty in that they were near or below a "C" average. It was hoped that by the selection of students who were in danger of being dropped for academic reasons (students falling below a "C" average for overall college work are subject to dismissal), the subjects selected would be more highly motivated toward attendance in a program which implied that some material benefits might be derived. Subjects were essentially normal from a vision standpoint; optometric examination disclosed

no significant uncorrected refractive errors or any indication of pathology.

PROCEDURE

All subjects participating were tested before and after training on the following tests and schedules:

1. Otis Test of Mental Ability (Higher Forms A and B—30 minutes)—A paper and pencil test of intelligence.
2. Iowa Silent Reading Test, New Edition (Form Am and Form Bm, Revised)—A group test of reading rate and comprehension.
3. Bernreuter Personality Inventory—A questionnaire revealing one's pattern of adjustment from the standpoint of neurotic tendencies, self-sufficiency, introversion - extroversion, and dominance.
4. Complete visual examination by a licensed optometrist according to the 21-point OEP schedule.

The experimental design called for three treatments plus a control:

| Group | Treatment | N |
|---|---|---|
| A | Visual Training | 16 |
| B | Visual Training and Counseling | 16 |
| C | Counseling | 17 |
| D | Control | 16 |

An optometrist classified subjects into visual training case types using the results of the optometric refraction, and all groups were equated with respect to case types. In addition, Otis Test of Mental Ability and Iowa Silent Reading Test scores were considered; often a lateral shifting of subjects within visual training case types was necessary to equate groups according to intelligence and reading test scores.

Students reported for training on alternate days three times per week over an eight-week period during the Spring Term, 1950. Each training session lasted about 45 minutes. A record of each student's progress was kept over the entire term. The course of visual training was one prescribed by Henry B. Day, Jr., O.D., Winston-Salem, North Carolina, who is associated with the Occupational Vision Research Project.

Counseling given was mostly of a vocational nature concerning discussion of measures of interests, abilities, and aptitudes along with interpretation of the measures in the light of the student's vocational choice. Some of the students counseled brought up more personal problems. As was mentioned previously, counseling was included in the

scheme of the design to attempt to satisfy the question concerning the motivation of the subjects who were not in the visual training groups. It was looked upon as a means of providing motivation and giving equal attention to subjects who were not taking visual training.

The following instruments were used in the study:

1. Arneson Korector—first eight sessions, or until proficiency in eye movement was attained.
2. Keystone Ophthalmic Telebinocular with Card Holder and Card AN 3 (Stereoscopic Star Pattern)—first session, or until subject could make at least three fixations per one-second flash.
3. Keystone Ophthalmic Telebinocular with Ortho-Trainer Head.
   a. Keystone Movie Cards, MA 1-10—used first four sessions.
   b. Keystone ANW Series Slides 16 - 35—used from fifth through eleventh sessions.
   c. Keystone AN Series Slides 1 - 26—used from twelfth through twenty-first sessions.
4. Keystone Correct-Eye-Scope—used throughout entire period of training.
5. Keystone Overhead Projector with Flashmeter Attachment—digit slides were used through first half of the training sessions and then discontinued.
6. Science Research Associates Reading Accelerator—used last six sessions, ten minutes per session.
7. Keystone Tele-Rotor Control Unit for Ophthalmic Telebinocular.

## RESULTS

Analysis of covariance has been used throughout in the analysis of these data.[5] Covariance adjustment tends to make statistical allowance for uncontrolled differences in the groups prior to treatment. Reading rate scores show statistically significant changes (Table I and Figure 1): an $F$ ratio of 5.43 is significant beyond the 1% level of confidence. Mean differences as tested by $t$ ratios are statistically significant for the two visual training groups, but are not beyond chance expectancy for the other two groups.

Statistically significant $F$ ratios are not demonstrated for reading comprehension (Table II and Figure 2), grade-point averages over the three terms (Table III), Otis Test of Mental Ability scores (Table IV), or Bernreuter Personality Inventory scores (Table V). Trends in favor of visual training are indicated by increased comprehension scores and slightly higher grade-point averages in the Fall Term, 1950-1951.

TABLE I

IOWA SILENT READING RATE MEAN STANDARD SCORES AND STANDARD DEVIATIONS FOR ALL GROUPS BEFORE AND AFTER VISUAL TRAINING

| | GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| PERIOD | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| Before Training | 75.33 | 13.89 | 71.43 | 6.54 | 74.46 | 13.88 | 68.86 | 11.71 |
| After Training | 92.07 | 11.07 | 84.71 | 15.57 | 79.00 | 12.63 | 72.29 | 13.92 |
| Mean Gain | 16.74 | | 13.28 | | 5.46 | | 3.43 | |
| N | 15 | | 14 | | 13 | | 7 | |
| | | | | | $F = 5.43^{**}$ | | | |
| $t$ (Before vs. After) | 4.66** | | 3.45** | | 1.71 | | .86 | |

**Statistically significant at the 1% level of confidence.

Note: The customary procedure of computing $t$ ratios to test the significance of differences between means only after finding a significant $F$ ratio has been followed.

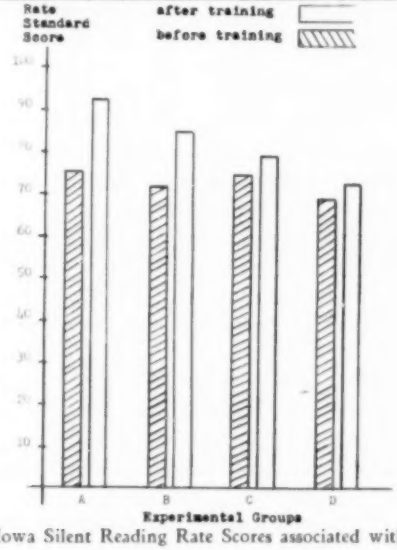


Fig. 1. Gains in Iowa Silent Reading Rate Scores associated with visual training.

TABLE II

IOWA SILENT READING COMPREHENSION MEAN STANDARD SCORES AND STANDARD DEVIATIONS FOR ALL GROUPS BEFORE AND AFTER VISUAL TRAINING

| | GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| PERIOD | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| Before Training | 84.80 | 13.74 | 82.07 | 14.06 | 82.15 | 10.67 | 90.43 | 13.76 |
| After Training | 87.73 | 14.78 | 87.71 | 14.24 | 84.92 | 17.50 | 87.57 | 10.85 |
| Mean Gain | 2.93 | | 5.64 | | 2.77 | | —2.86 | |
| N | 15 | | 14 | | 13 | | 7 | |
| | | | | | $F = .26$ | | | |

Note: $F$ Ratio not statistically significant at the 5% level of probability.

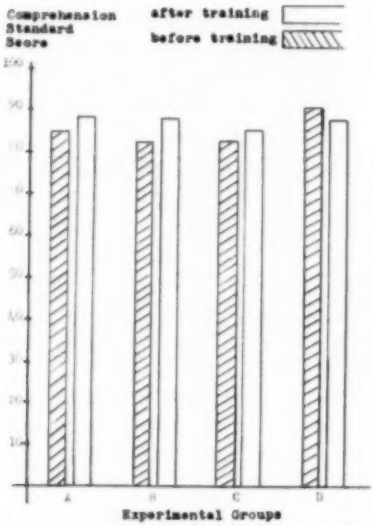


Fig. 2. Gains in Iowa Silent Reading Scores associated with visual training.

TABLE III

MEAN GRADE-POINT AVERAGES AND STANDARD DEVIATIONS FOR ALL GROUPS BEFORE, DURING, AND AFTER VISUAL TRAINING

| | GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| PERIOD | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| Before Training (Winter Term) | 1.14 | .21 | 1.08 | .43 | 1.17 | .55 | 1.00 | .61 |
| During Training (Spring Term) | 1.26 | .94 | 1.11 | .54 | 1.25 | .62 | 1.56 | .34 |
| After Training (Fall Term) | 1.16 | .35 | 1.23 | .31 | .97 | .66 | 1.07 | .57 |
| Mean Gain (After Training Minus Before Training) | .02 | | .15 | | —.20 | | .07 | |
| N | 6 | | 7 | | 9 | | 13 | |

| $F$ | Winter-Spring | Winter-Fall | (A + B) — (C + D) Spring-Fall | (C + D) Spring-Fall |
|---|---|---|---|---|
| | 2.29 | .41 | .39 | .97 |

Note: No $F$ ratios are statistically significant at the 5% level of confidence.

DISCUSSION

It was expected that there would be some attrition of subjects during the training period. Unfortunately, many of the subjects were lost from the control group—it was not possible to get these subjects back for the retest at the conclusion of training. Despite the curtailment of subjects, a reliable gain in reading rate has been evidenced for the

TABLE IV
OTIS TEST OF MENTAL ABILITY MEAN RAW SCORES AND STANDARD DEVIATIONS BEFORE AND AFTER VISUAL TRAINING

| | GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| PERIOD | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| Before Training | 49.87 | 9.08 | 49.43 | 7.17 | 48.46 | 8.86 | 52.00 | 5.42 |
| After Training | 50.93 | 7.95 | 48.50 | 9.11 | 48.23 | 8.57 | 53.71 | 3.71 |
| N | 15 | | 14 | | 13 | | 7 | |

$F$ (Before training) = .24
$F$ (After training) = .67

Note: $F$ ratios not significant at the 5% level of confidence.

visual training groups. This gain of from 13 to 16 standard score units represents a gain in reading rate of about 30%, or an average gain of about 65 words per minute. (Thirteen of the subjects who received visual training were tested for reading rate and comprehension during the Fall Term, four months after training—there had been no significant decline during the summer months.) Small gains are shown in comprehension (Table II).*

It has been noted previously that other investigators have not found that visual training resulted in permanent improvement from the standpoint of measurable refractive findings. This has been true especially when subjects did not exhibit marked refractive errors. It would seem that some additional criterion of visual performance may be used in addition to refractive findings to determine the degree of improvement. A sensitive standardized test of reading ability may provide that criterion inasmuch as reading skills do not seem to decline after training has been discontinued. In addition, such a criterion (if justifiable) presents a measure of objective improvement to the patient.

It yet is uncertain whether or not the problem of subject motivation in an experimental setting has been solved. It is felt that motivation of the counseling group was sustained equal to that of the groups receiving visual training or visual training and counseling. This conclusion is reached by way of subjective observation and by scanning the reading test and personality schedule scores (Tables I and V). The fact that gains in reading rate and comprehension were better for Group C than for Group D supports the idea that *something* was influencing Group C in order that these differences result. With respect to reading

*Research studies generally indicate a significant correlation between reading rate and comprehension. In this experiment a correlation of .20 between initial reading rate and comprehension was found; such a low correlation is not beyond chance expectancy. Such a low relationship, however, may be a result of the way in which comprehension was measured by the test used. From experience using the Iowa Silent Reading Test, it is felt that the comprehension portion of this test is valid only for very slow readers who have not read fast enough to cover the test passage more than once.

rate gain for Group C especially, a $t$ value of 1.71 is significant at the 12% level and suggests that something other than visual training, viz., motivation administered in the form of counseling, was responsible for this strong trend. Apparently, something associated with this counseling seems to have had an effect upon reading ability—but visual training had a much more significant effect.

Grade-point averages* were computed according to the formula of:

$$GPA = \frac{\text{Points Earned} - \text{Hours Failed}}{\text{Total Hours}}$$

None of the mean differences in averages is significant. Groups C and D, which did not receive training, show more improvement during the Spring Term when visual training took place, but that advantage is not evident in the Fall Term averages; in fact, the situation is reversed (Table III). Possibly failure to be placed in either the visual training or counseling groups created resentment and worked as an incentive toward greater effort for the control group. It will be noted, however, that if averages during the term of visual training are disregarded, the visual training groups tend to maintain or increase their academic performance

TABLE V

BERNREUTER PERSONALITY INVENTORY MEAN STANINE SCORES AND STANDARD DEVIATIONS FOR ALL GROUPS BEFORE AND AFTER VISUAL TRAINING

| | GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| PERIOD | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| BEFORE TRAINING | | | | | | | | |
| B1-N (Neuroticism) | 5.53 | 2.58 | 5.28 | 1.55 | 5.59 | 1.49 | 5.61 | 2.88 |
| B2-S (Self-Sufficiency) | 3.74 | 2.07 | 3.52 | 1.82 | 3.50 | 1.73 | 3.27 | 1.85 |
| B4-D (Dominance) | 4.36 | 2.40 | 3.88 | 1.51 | 4.37 | 1.16 | 3.67 | 2.70 |
| AFTER TRAINING | | | | | | | | |
| B1-N (Neuroticism) | 4.46 | 2.66 | 4.28 | 2.26 | 4.01 | 2.13 | 4.91 | 2.73 |
| B2-S (Self-Sufficiency) | 4.36 | 1.87 | 4.69 | 1.99 | 4.75 | 2.03 | 3.76 | 1.86 |
| B4-D (Dominance) | 5.30 | 2.29 | 5.21 | 1.88 | 5.79 | 2.09 | 4.17 | 2.24 |
| MEAN GAIN | | | | | | | | |
| B1-N | +1.07 | | +1.00 | | +1.58 | | +.70 | |
| B2-S | + .62 | | +1.17 | | +1.25 | | +.49 | |
| B4-D | + .94 | | +1.33 | | +1.42 | | +.50 | |
| N | 15 | | 14 | | 13 | | 7 | |
| | B1-N | | B2-S | | B4-D | | | |
| $F$ | .56 | | .94 | | .84 | | | |

Note: No $F$ ratios are statistically significant at the 5% level of probability.

| *Grade | Points per Credit Hour |
|---|---|
| A | 3 |
| B | 2 |
| C | 1 |
| D | 0 |
| F | —1 |

while the non-visual training groups tend to decline. When one considers academic performance in the light of the group's potential for academic achievement as reflected by Otis Test scores (Table IV), the groups which received training are achieving nearer their capacity than the other groups. Only the averages of subjects who were in attendance throughout all three terms are included in these averages shown. This will explain the differences in N's on this table as compared with the other tables reflecting test-retest scores (before and after training).

No change can be seen in Otis Test of Mental Ability scores (Table III). This would not support claims that visual training will enhance one's intellectual capacity; undoubtedly, visual training may improve one's ability to learn.

Only three of the four scales of the Bernreuter Personality Inventory have been included in the data. The introversion-extroversion scale B3-1 is highly correlated with B1-N, neuroticism, so frequently it is not included as part of the pattern of personality traits measured. An inclination toward neurotic tendencies is measured by Scale B1-N; low scores are most desirable on this scale. Scale B2-S is a measure of self-sufficiency; high scores are most desirable from the standpoint of good adjustment. B4-D is a measure of dominance; high scores again represent better adjustment.

Bernreuter scores in percentile form are not suitable to the analysis of variance technique. Therefore, all percentile scores were converted to stanine scores before covariance was applied. None of these *F* values is significant at the 5% level (Table V). All groups show improvement on the retest with those receiving counseling being generally higher. This may demonstrate better adjustment, but more likely, it is an indication of improved knowledge of what the questionnaire means and a knowledge of how to answer the questions to one's best advantage.

The design of this experiment does not permit the isolation of any particular instrument or technique as being responsible for changes effected. It is felt that the whole complex of visual stimulation has been responsible for the changes observed. It is known that tachistoscopic training alone can result in as great or greater gain in reading ability.[8] Experimentation with non-credit freshmen English classes has demonstrated the effectiveness of tachistoscopic training alone in improving reading skills.* It is reasonably certain that tachistoscopic training has not been the determining factor in this study since tachistoscopic training was discontinued midway through the experiment because the students did not enjoy this aspect of the training and were showing no ap-

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preciable increase in digit span. Nor is it felt that the use of the reading accelerator has played much part in the gains achieved in this study. This apparatus was used only during the last six training sessions, 10 minutes per session.

The next step in experimentation of this nature would seem to be the isolation of the instruments or combinations of instruments useful in bringing about the changes shown. This could be accomplished through a factorial design wherein one systematically varied the training time spent on each portion of it to arrive at the most efficient technique or instrument or combination thereof.

The effect that visual training has had upon the visual characteristics of the subjects and the relationship between the visual characteristics and personality adjustment scores are corollaries to this report. The first involves some 60 variables extracted from the records of refraction given before and after training, and the relating of each of these variables to the results reported herein. The second is a statistical determination of vision-personality relationship. The magnitude of the study necessitates their being reported separately.

## SUMMARY AND CONCLUSIONS

Forty-nine college students participated in a visual training study, 15 in a visual training group, 14 in a visual training plus counseling group, 13 in a counseling group, and 7 in a control group. Training sessions were held three times per week over an eight-week period. Tests given before and after training, and an analysis of grade-point averages before, during, and after training show the following results:

a. Gains in reading rate were significant at the 1% level of confidence for subjects undertaking visual training.
b. Trends favoring the visual training groups are shown for reading comprehension and academic achievement, but statistically reliable gains are not demonstrated.
c. Personality inventory scores show general trends toward better patterns of adjustment for all subjects participating with the exception of the control group, but such trends are regarded as not being a function of the experimental situation but the result of "test-wiseness" on the part of the subjects.
d. Mental ability test scores demonstrate no consistent trends nor any statistically reliable changes as a result of visual training experience.

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## ABSTRACTS

ORTHOPTICS—A CRITICAL APPROACH. H. B. Marton. The British Journal of Physiological Optics. 7.2.79-85. 1950.

The author reviews the work done in overcoming abnormal retinal correspondence and the psychological orthoptic techniques of Cantonnet. He also discusses the work of the South African ophthalmologist, Stutterheim, and his kinetic treatment of convergence problems with prisms and prism exercises. He also refers to those cases with improper bifoveal coordination, particularly in heterophoria, wherein the fusional amplitudes are stimulated to overcome the demands made by the imbalance.

All in all, the author finds the literature dealing with orthoptics is now more or less repeating itself and Marton wonders if the speciality has now come to "the end of its tether." He reviews the modern techniques and while finding them some better than the old, he nevertheless sees in the new much of the same old occlusion, flashing, oscillation, alternation and rotational visual chasing which has characterized orthoptics for years. The author seems to feel that current treatment techniques consist mainly of the old, with the only change being in the vigor of the attack upon the problem.

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# PTOSIS OF THE LIDS—REVIEW AND CASE REPORT*

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A ptosis of the lids is observed as a deficient elevation of the upper eyelid reducing the aperture to a size which interferes with vision, particularly that of upward gaze. The patient's adjustments are attempts to raise the lids by contracting the occipito frontalis which wrinkles the forehead and elevates the brows, giving the patient a surprised expression. Tilting the head backward depresses the eyes to a point where some vision can be accomplished through the aperture. There are few conditions which produce a more pained or strained expression than that found in ptosis.

Although the correction of the causal factors invariably falls outside the field of the optometrist a basic knowledge of its etiology is of value both in referral of cases and in providing relief for the result. A short review of the physiology makes the mechanism responsible for the condition clear.

The opening (levator) muscles and the closing (orbicularis) muscles are somewhat different in that, although they are antagonistic muscles they do not share the reciprocal innervation of the other extrinsic eye muscles. Because of this failure to relax appropriately during contraction of the antagonist muscle, a less exaggerated change in lid position results from an over-stimulation of one of the muscles. Therefore, ptosis may well vary in degree from a slight droop to a complete closure of the lids.

The levator palpebrae receive third cranial nerve and sympathetic nerve innervation while the orbicularis is stimulated by the seventh cranial nerve and possibly the inferior branch of the third. Ptosis, therefore, can be a result of damage to these nerves.

Anatomical relations are also significant here. The oculomotor nerve from the nuclei of the mid-brain to the insertion in the levator is in close proximity to blood vessels and bony structures and, hence, it is easily seen that pressure may be exerted against this nerve by aneurysms, tumors, arteriosclerosis, etc., which all result in defective nerve impulse transmission. The oculomotor nerve does not divide into a separate lid branch early in its course and, therefore, most nerve injuries will

*Submitted on August 7, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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involve oculorotary movements unless only the terminal branches are affected. This should explain the rarity of isolated ptosis cases.

Clinically ptosis can occur in the following forms:

*A. Congenital and hereditary types.* (1) Hereditary Progressive ophthalmoplegia is a condition isolated to the eyes, is progressive in character, and results finally in complete immobility of the eyes. (2) Coloboma of the levator is not rare because the levator is the last muscle to be differentiated embryologically. Usually the other colobomata are present but not always.

*B. Compression.* (1) Arteriosclerosis produces a levator defect in older persons subject to this condition. The hardening and tortuosity of the vessels may exert pressure on the nerve and interfere with normal nerve impulse transmission. (2) Aneurysms of the Internal Carotid. This effect results from the intimate relation of the internal carotid and the oculomotor nerve in the cavernous sinus. The nerve is compressed against the bony structure and its function depressed. This is the most common reason for sudden, isolated, oculomotor palsy. (3) Tumors produce a similar compression effect particularly if situated in cavernous sinus.

*C. Nutritional Types.* (1) Wernicke's encephalopathy is characterized by varying degrees of bilateral ophthalmoplegia, nystagmus, ataxia, and other symptoms. Pathologically the gray matter, especially in the third ventricle is affected and probably produces the palsy by nuclei damage. It is nutritional because it is found in pyloric stenosis alcoholism, etc. (2) Thiamine deficiency as in Beriberi produces abducens palsy and ptosis commonly along with the other non-ocular symptoms.

*D. Nerve disease forms.* (1) Multiple Sclerosis may produce ptosis but is somewhat rare although 25 to 30 per cent of the cases show oculomotor defects. (2) Herpes Zoster affects the third nerve most frequently and only the levator may be involved although all nerves can be damaged. (3) Myasthenia Gravis has as one of its earliest signs the lid droop preceding other bodily defects. The basis seems to be in the nerve synapse. (4) Paralysis of the sympathetic supply is also called Horner's syndrome and includes an absence of sweating on the affected side, a constricted pupil, and a ptosis. (5) Lesions of the angular gyrus and temporal lobe can produce a ptosis. A similar effect can be seen in certain occipital and frontal lobe lesions.

*E. Bacterial Forms.* (1) Botulism produces its effect by the exotoxin of the bacillus botulinus which produces hemorrhages in the gray matter affecting the nerve endings and causing levator palsy. Almost

always there is internal ophthalmoplegia. (2) syphilis used to be the cause of one-half of all the ophthalmoplegias. Its effects on nervous tissue are well known.

F. *Hysterical Form* usually has a spastic orbicularis cause accompanied by photophobia and corneal hyperesthesia. The condition is bilateral and great lacrimation is present.

These diseases do not constitute by any means a complete list of all known etiologies of ptosis. They are merely listed here as examples in the consideration of the physiology operating where there is a lid elevation impairment. It can readily be seen that any systemic disease which extends to the gray matter can be the cause.

What we are concerned with as optometrists is the method of helping the cases where no medical care can be devised for the disease or where permanent damage has been done and a cosmetic improvement is desired or where a restricted field of vision is present.

A case history may illustrate how this often can be done. The patient was a man 26 years of age with an almost complete bilateral ptosis complicated by a jerky nystagmus, lateral in direction and of medium frequency. A consultation revealed no significant medical history but that the patient's war experiences were responsible for a great nervous state. A restricted vision was achieved by violent use of the occipito-frontalis muscle and the inclination of the head backwards. Visual fields were greatly reduced by the very small lid opening and he grew very tired as a result of the difficult head posture and misuse of the accessory facial muscle.

His description of the onset of the disease was that it gradually appeared and became worse about two years after his discharge from the army. An encephalograph record had been made and nothing significant had been discovered.

The refractive error was: O.D. —1.50 D. sph. ⌒ —1.00 D. cyl. axis 40. O.S. —1.75 D. sph. V. A. = 20/20, O.D., O.S. or O.U.

Ophthalmoscopically there was no evidence of any retinal disease or degeneration to account for the nystagmus nor any papilla change evidencing a neoplasm. It seemed that here was a typical hysterical condition because the usual photophobia and corneal hyperesthesia were absent.

It was decided to make a pair of ptosis crutches to elevate the lids to a normal height. This conclusion was formed not merely as a result of a need for the devices but because of a very excellent attitude of the patient toward wearing anything which would help.

In selection of materials for this device it was necessary to use a

frame very rigid and capable of a tight, though comfortable, adjustment. Since a very precise fit would be required on the crutches the frame had to be adjustable in an antero-posterior direction.

The material for the crutches had to be such as to resist deformation, be non-corrosive (as it would be in direct contact with the lids) be resilient enough to permit a blinking reflex, thin enough to be invisible when the lid folds over it, and thick enough to distribute the rather great pressure necessary to elevate the lids.

A zyl frame was used which had rocking pads and library temples. It was decided that this was the superior type for this specific case because it was adjustable and any less rigid type would not retain its shape under the persistent blinking of the crutches.

For the crutch wire, an 18k gold round wire alloyed with 14½ % palladium and platinum of .040 diameter was used. The dimension was thick enough to provide a good bearing surface but still be inconspicuous. It has a high temper which can be reduced for easy bending by heat treating.

The assembly was done by attaching with beeswax the straight wires to the junction of the pad arms and the metal bottom of the frame. To eliminate unnecessary bending the attachment was made about 30° superior and 70° temporal from the plane of the lenses. The entire device was invested in stone with only the waxjoint exposed. After the wax had been melted off with hot water the joint was soldered. In this way the original temper was not lost in the wires since they were not exposed to the heat, making retempering unnecessary.

The frame was fitted to the patient's face with the nose pads so adjusted that it rested slightly forward, further away from the eyes than normal. The wires were then bent and fitted with the patient's eyes closed so that a uniform bearing surface was maintained continuously from a point mid-way between the inner canthus and nasal iris edge to a point midway between the outer canthus and the temporal iris edge. The wire was not only fitted to conform exactly to the eyeball but also to follow the orbital ridge throughout its entire length.

The nose pads and temples were then adjusted to position the frame back and up, to provide the right degree of tension required. With the device in place the lids were lifted to the desired height by pulling the brows upward. The pressure between the two eyes was then balanced by further nose pad adjustments.

A fold of skin will cover the wire throughout most of its length if it is fitted high enough in the orbit and good conformation is present, and there will be little tendency for the lids to slip.

In order to permit a natural blinking reflex it was necessary to reduce the top and bottom of an area of the wire not in contact with the lids although after a few days the blink became stronger. A very fine roughening of the posterior surface of the wire was not necessary to give any additional traction in this case.

The results were good. The patient immediately was able to wear the crutches continuously and in complete comfort. The facial muscles relaxed improving the expression to almost normal and after a few days the head tilt had disappeared. The visual field is normal.

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## *ABSTRACTS*

MY FIFTY YEARS IN OPTOMETRY. Albert Fitch. Alumni Bulletin, Pennsylvania State College of Optometry. Part I. and Part II. 6.3.1-11, 1952, and 6.4.1-12, 1952.

Albert Fitch, President of the Pennsylvania State College of Optometry, entered the profession 50 years ago, and as another of his many contributions to optometry is now reviewing for the profession some of the past in which he has played such an important role.

The first and second installments of his memoirs have now been published. The author reviews his introduction to optometry. His early training 50 years ago. His association with Dr. Shoptaugh. The opening of his own office in 1906. The subsequent opening of two branch offices. His employment of physicians and optometrists to assist him in his practice. His entry into early optometric organizational activities. His meeting with Dr. Otto Haussmann in 1912. The unexpected action of the Medical Board to license optometrists under the medical practice act. The division in optometry over this point and the fight which lead to the famous injunction against the Pennsylvania Medical Board in which the courts held that optometry was not a part of the practice of medicine. This and much more has been told by the author in a most entertaining manner, and in such a way that his report will be of great value to historians in the years to come. This reviewer looks forward to the additional sections of these memoirs with keen interest.

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# FUSION—ITS LOSS AND RETURN—A CASE REPORT*

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## PURPOSE

The purpose of this paper is to report a case wherein fusion was demonstrated at the age of 54, after at least four years of suppression. In the course of a normal practice of optometry, a good many cases of suppression are seen. Also it is not unusual to find discrepancies in the vertical alignment of the eyes. Presented herein is a case in which there is a marked vertical displacement of one orbit with complete suppression of either eye.

## HISTORY

Mrs. E. T., 50, first came into our office July 30, 1948. Her symptoms were typical of presbyopia. Her chief complaint was difficulty at near point. Her symptoms of visual discomfort were minimal.

## EXTERNAL EXAMINATION

A left meningioma was observed. It was located in a superior temporal portion of the orbit, causing an orbital decompression. Previous medical history indicated that it was first operated on in 1943 at the University of California Clinic with incomplete removal because of mechanical difficulties. At this time the size of the tumor was such that it was necessary to use a 6″ overall temple on the right side and a 7¼″ skull temple on the left side, hand-formed to circumvent the projection, in order to attain reasonable alignment of the lenses before the eyes.

## OPHTHALMOSCOPIC EXAMINATION

The fundi were normal in color. The discs were normally cupped. The ratio of vessels was as expected. No obstructions were present in the corneas, anterior chambers, lenses, or posterior chambers. Palpation indicated equal pressure. No signs of ocular pathology were visible.

## ANALYTICAL FINDINGS

On March 24, 1952, this patient was again examined. She reported that in 1949 and again in 1951 the tumor was operated on and removed. There was a depression in the temporal process of the

*Submitted on September 10, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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left frontal bone. Casual observation indicated that, as noted in 1948, the left orbit was lower than the right. (See Figure 1.)

**Fig. 1**

Visual acuity without correction: O.D. 20/100+, O.S. 20/100, O.U. 20/100.

Ophthalmometer: O.D. —1.00 D.C. axis 165. O.S. —1.00 D.C. axis 165. When shifting the A.O. Micromatic Ophthalmometer from the right to the left eye it was necessary to lower the eye piece exactly 6 mm. in order to view the center of the pupil. It is therefore safe to assume that the left pupil is located 6 mm. lower than the right pupil. The head was carefully positioned so that the mid-sagittal plane was perpendicular to a spirit level positioned on the headrest.

Static Retinoscopy: (These are net findings.) O.D. +2.50 D.S. ⊃ —0.50 D.C. axis 165. O.S. +2.50 D.S. ⊃ —0.50 D.C. axis 180.

Dynamic Retinoscopy: (These are net findings.) O.D. +4.50 D.S. ⊃ —0.50 D.C. axis 165. O.S. +4.50 D.S. ⊃ —0.50 D.C. axis 180.

Subjective Findings: O.D. + 2.50 D.S. ⊃ —0.50 D.C. axis 165. V.A. 20/20. O.S. + 2.75 D.S. ⊃ —0.50 D.C. axis 143 V.A. 20/20. V.A. O.U. 20/20.

Phorias: Distance, 1 to 2 Eso.—*no hyperophoria*. Near, 5 Exo, (through +2.25 D.S. Add) no hyperphoria.

Ductions: Adduction, distance 16/29/4, near 16/30/8. Abduction, distance X/7/2, near 17/30/20. These findings were taken through the +2.25 add. R. Supraduction 5/3. R. Infraduction 4/1. These findings were considered so important that no less than 20 meas-

urements were made. The figures recorded represent the average numerical finding.

Gradient: 2 to 4 / +1.00 D.S.

Accommodative Amplitude: O.D. 3.00 D. O.S. 4.00 D.

Visual Skills: Significant here, is that fusion for both distance and near plus stereopsis were significantly present. First, second, and third degree fusion could be demonstrated by the Keystone Visual Skill cards.

Simultaneous Vision: Variations of the Worth Four Dot Test were given. With room lights on, and also in complete darkness, at 6 M, at 1 M, at 16"—simultaneous vision with no diplopia was reported.

CONCLUSIONS

The data presented above indicate that in 1948, and probably for some time prior to that, this patient did not have simultaneous vision. The considerable mechanical distortion of the left orbit and its effect upon the fusion faculty apparently prevented simultaneous binocular vision with fusion. Significantly, however, it did not prevent the attainment of optical emmetropia and Snellen 20/20 acuity.

Subsequent removal of the tumor still left an obvious vertical disparity of the two orbits and globes. However, undoubtedly because of the maintenance of high acuity in both eyes this patient was able to achieve single binocular vision. It is safe to assume that because of the return of this condition, the previous supression was not deep-seated.

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## *ABSTRACTS*

CENTENNIAL OF THE INVENTION OF THE OPHTHALMOSCOPE. C. Wilbur Rucker. The Sight-Saving Review. 20.4. 207-210. 1950.

Rucker points out that the invention of the ophthalmoscope was responsible more than any other single factor for the development of the medical specialty of ophthalmology. The author reviews the early theories on the interior of the eye and pays tribute to Hermann von Helmholtz for the research which brought the ophthalmoscope into being. An early instrument is illustrated.

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# TARGETS AND TESTING PROCEDURES FOR THE MEASUREMENT OF VISUAL ACUITY WITHOUT GLASSES*

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## INTRODUCTION

The material presented in this paper deals with the same problem which was discussed in a previous paper.[1] In the original paper, the analysis of the effect of blurredness was made by a photometric determination of iso-illumination lines in the retinal image which is much more precise than the type of analysis described in the present paper which involves the use of photography. The photographic method, however, has the advantage in that it is much easier for the reader to visualize the effects of blurredness. Actually the two methods of demonstrating the effects of blurredness complement each other, the one being qualitative and the other being quantitative. The same general conclusions can be deduced from either method of analysis.

In working out a target or test procedure there are a number of different factors to be considered such as the reliability of the subject's judgment, the size of the pupil, the state of accommodation, and the presence or absence of astigmatism. In the case of astigmatism, one has to be concerned with the relation of the orientation of the target to the principal meridians of the eye, and also with whether the measure obtained represents a measure in the more blurred or the less blurred of the two principal meridians or some intermediate value.

## RELIABILITY OF THE SUBJECT'S JUDGMENT

When the experimenter can rely upon the subject's ability and willingness to report when a line, point, or gap becomes visible, he can make use of simple patterns such as those illustrated in Figure 1. As the size is gradually decreased, the subject reports when the point, line, or gap becomes no longer visible. In psychophysics this type of procedure is known as the method of limits.

When it is felt that one cannot rely upon the subject's judgment as to whether he does or does not see a gap, line, or point, or an

*Submitted on July 6, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
Aided by a grant for research in physiological optics by the Bausch & Lomb Optical Company.
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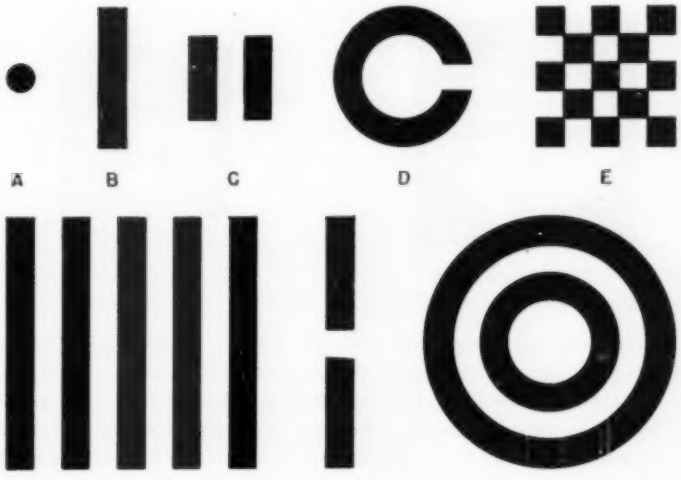


Fig. 1. Visual acuity test objects.

articulated field in the case of the checkerboard pattern, it is necessary to use more complicated test objects and a more complicated procedure which is known in psychophysics as the method of constant stimuli. This type of procedure is characterized by the fact that the patient knows that he is to be confronted with two or more different targets or orientations of the same target and that he will have to report what target or orientation has been presented.

For example, in the case of the Landolt broken ring the target may be presented with the gap oriented to the right, left, up, or down and correspondingly the subject reports that he sees the gap in one of these positions or else guesses it is to be located at one of these positions.

This test can be modified by using eight different positions instead of four, or by using two gaps in each ring.

In the case of the Bausch & Lomb checkerboard pattern (Figure 2), the checkerboard may be located at any of four positions.

The Keystone visual acuity target (Figure 3) may have the dot located in any one of the five squares.

In this type of testing procedure, the ideal arrangement is to present each target size a large number of times with the gap, checkerboard, or dot appearing in each of the various positions an equal number of times, and there should be no factors which would cause the subject to guess one position more frequently than another.

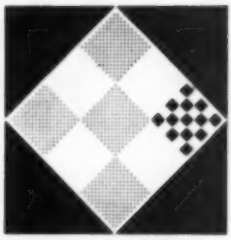

Fig. 2.
Keystone visual acuity test object.

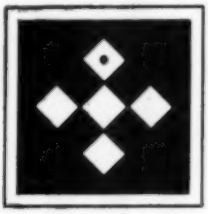

Fig. 3.
Bausch & Lomb checkerboard pattern.

To illustrate the general principle let us assume that a test chart similar (but larger) to Figure 4A is used. This chart, of course, is not suitable for visual testing because the change in position of the gap from one ring to the next follows the same sequence in each row. Furthermore, each size of ring ought to be presented not four times but, say, 100 times. The chart has been prepared solely for the purpose of demonstrating the optical principles. At least it conforms to the general principle that each position of the gap is presented an equal number of times. If we assume that a chart of this sort is placed at

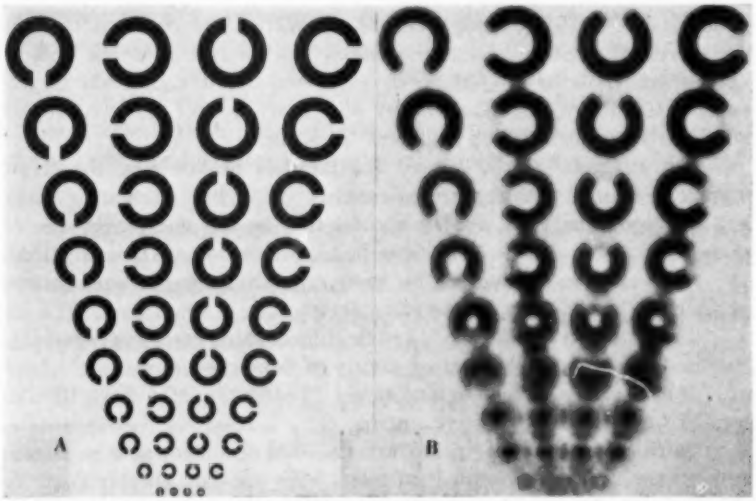


Fig. 4. Fig. 4A represents a chart placed at 6M. from the eye with the smallest test objects subtending a visual angle of 5 minutes. Fig. 4B represents the appearance to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +1.87 D.S. placed in the primary focal plane.

20 feet and the smallest ring subtends 5 minutes at the eye, the effect obtained in Figure 4B is comparable to what an emmetropic eye would see looking through a + 1.87 D. sphere and a 3 mm. artificial pupil placed in the primary focal plane. Starting with the smallest size ring the subject would have to guess the position of the gap and his chance of a correct answer would be one out of four. As he would pass from smaller to larger rings the percentage of correct guesses would gradually increase until he would be able to see and specify correctly four out of four. In this sort of procedure one can analyze the results by drawing a size-frequency graph, such as shown in Figure 5, in which the frequency or percentage of correct answers is plotted against the size of the target.

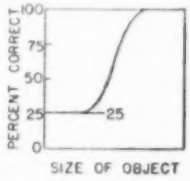


Fig. 5. Size-frequency graph for the judgment of the position of the gap in a Landolt broken ring which is presented with the gap in four positions. The graph shows the percentage of correct answers for different sizes, and illustrates the case of an eye free from astigmatism but out of focus.

It is necessary to specify a certain percentage of correct answers as a criterion for passing or failing. This choice is not altogether arbitrary. The curve in Figure 5 which represents the transition from the 25 per cent level to the 100 per cent level can be assumed to have the form of the integral of the probability curve. At least this is the most satisfactory guess that one can make without an experimental determination. One aims to select a percentage value for passing which will correspond to the inflection point of the curve. In the case in question 60 per cent would represent a satisfactory approximation.

THE ROLE OF ASTIGMATISM

When the eye is free from astigmatism but out of focus for the target, the blur circle on the retina produced by a point source is circular and therefore rotating the target with respect to the eye will have no effect upon the distribution of intensity in the retinal image. When astigmatism enters into the situation the blur circle becomes transformed into either an ellipse or a line which is a special type of ellipse with a zero minor axis. The only exception to this rule is the case in which the middle of the interval of Sturm falls at the retina and in this case the image of a point is a circle.

Whenever the image formed by the point source is elliptical, the distribution of intensity in the retinal image of a complex pattern may vary with the orientation of the target with respect to the major and minor axes of the ellipse.

PUPIL SIZE AND STATE OF ACCOMMODATION

In the measurement of visual acuity without glasses it is necessary to pay attention to the size of the pupil and the state of accommodation but in this paper which is concerned primarily with the configuration and orientation of the target it will be assumed that the pupil size and state of accommodation remain constant.

JUSTIFICATION FOR THE USE OF SIMPLE BLUR CIRCLE THEORY

In comparing the relative merits of different types of test objects, use will be made of simple blur circle theory, according to which each point in the test object produces an image on the retina which has the shape of a circle or ellipse and the light in the image is uniformly distributed over this area. The use of this theory makes it possible to illustrate effects obtained with different types of test objects by using photographs produced with an ordinary camera equipped with auxiliary lenses.

The half-tone illustrations which have been used to illustrate effects obtained with astigmatic and out-of-focus eyes were produced by using a camera thrown out of focus with spheres and cylinders placed in front of the camera lens, and the degrees of blurredness thus achieved were computed to be equivalent to those obtained by an emmetropic eye looking at the targets through a 3 mm. artificial pupil and various combinations of spheres and cylinders.

It is probably necessary to present some justification for the use of simple blur circle theory in the analysis of the problems connected with the measurement of visual acuity without glasses. It must be recognized at the outset that there are limits beyond which the blur circle theory will not apply. Theoretically according to simple blur circle theory, it should be possible to obtain a point image of a point source when the eye is in focus but instead of achieving this degree of perfection there is a range between approximately 0.50 D. out of focus in one direction to 0.50 D. out of focus in the other direction in which the image is much more diffuse than would be predicted by simple blur circle theory. This diffuseness can be attributed to spherical aberration, chromatic aberration, and diffraction, and in some cases to irregular astigmatism, aspherical surfaces, non-homogenous media, and obliquity of incidence of light rays at the refractive surfaces. However, when the

eye is out of focus by more than 0.50 D., the light is fairly well confined to and uniformly distributed over the circle or ellipse predicted by simple blur circle theory. At least this assumption represents a close approximation to the truth. The more out of focus the eye becomes the more rigid becomes the agreement between theory and actuality.

There are of course instances in which irregular astigmatism and regular or some irregular form of spherical aberration may produce distributions of intensity which do not conform to simple blur circle theory, but these are to be considered exceptions to the rule. They cannot be ignored in the evaluation of visual acuity data but in designing tests for visual acuity it is necessary to design tests which will provide for cases that conform to the rule and supplement the procedure to screen out the exceptions to the rule.

In measuring visual acuity with glasses which permit maximum acuity, blur circle theory definitely does not apply. The principles which do apply to this situation have been analyzed in a previous paper.[2] The question which has to be answered is whether a different set of principles has to be evoked to take care of the measurement of visual acuity without glasses in cases of myopia, hyperopia, and astigmatism of less than 0.50 D. It should be possible for these degrees of ametropia to make use of the same targets that are used for higher degrees even though visual acuity measurements in this situation take on a different significance.

## MEASUREMENT OF VISUAL ACUITY WHEN THE PRINCIPAL MERIDIANS ARE NOT KNOWN

There are several methods of coping with this situation. One is to use a test object which is not dependent upon the relation of orientation of the test object to the principal meridians. The simplest pattern to use is a single dot or disc (Figure 6A). The retinal image (Figure 6B) will be blurred differently in different directions depending upon

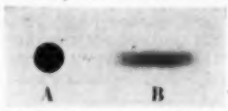


Fig. 6. Fig. 6A represents a black disc on a white background placed at 6M. from the eye and subtending a visual angle of 5 minutes. Fig. 6B represents the appearance to an emmetropic eye looking at the disc through a 3 mm. artificial pupil and a +0.37 D.S. ⌣ +1.50 D.C. axis 90 placed in the primary focal plane.

the orientation of the principal meridians but rotating the disc will not affect the result. In order to use this type of test object to measure the blurredness of the retinal image, it is necessary to reduce the size until the blurred image of the disc is no longer visible. The degree of

blurredness in the less blurred of the two principal meridians determines the threshold. Increasing the blurredness in either direction will (1) increase the diameter of the blurred image and (2) also decrease the contrast. But in the case of the more blurred of the two principal meridians, the increase in length compensates the loss in contrast and the threshold remains essentially unchanged. However, in the case of the less blurred of the two principal meridians, the increase in width does not compensate the loss in contrast.[3, 4]

The concentric ring target (Figure 1H) is also independent of the orientation of the target. It can be used to measure acuity for the most blurred or the least blurred of the two principal meridians. It has a further advantage that the target is applied to both principal meridians at the same time.

If a chart like that shown in Figure 7A is placed at 20 feet with the smallest pair of rings subtending 9 minutes of arc, Figure 7C repre-

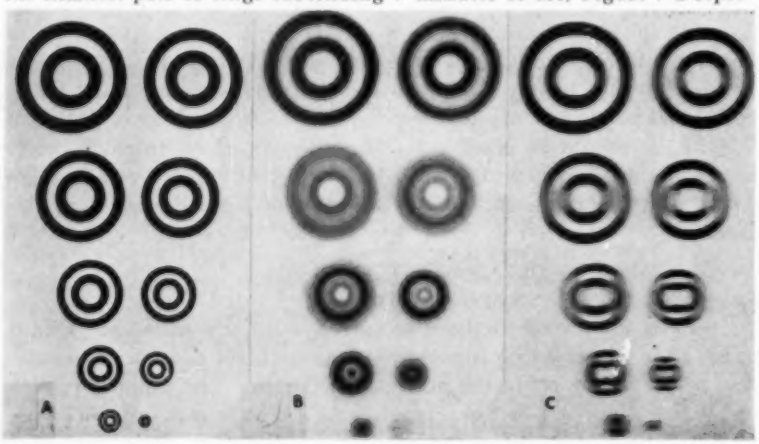


Fig. 7. Fig. 7A represents a chart placed at 6M. from the eye with the smallest test object subtending a visual angle of 9 minutes. Fig. 7B represents the appearance to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +1.87 D.S. placed in the primary fc. l plane. Fig. 7C represents the appearance to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +0.37 D.S. ⊃ +1.50 D.C. axis 90.

sents what would be obtained if the chart were observed by an emmetropic eye through a + 0.37 D. S. ⊃ + 1.50 D. C. axis 90 and a 3 mm. artificial pupil placed in the primary focal plane. The size of pattern at which the two rings appear to fuse at two points on opposite sides constitutes the measure for the more blurred of the two principal meridians and the size at which the remaining portions of the rings fuse determines the measure of acuity for the less blurred of the two meridians.

Another solution to the problem is to use a single bar test object (Figure 1B) and to measure the contrast threshold with the bar oriented in at least three different directions. One can deduce from this data the acuity for each of the two principal meridians and the orientation of the principal meridians.

As will be explained later, it is possible to work out a testing procedure employing the Landolt broken ring which will provide a measure of acuity which is independent of the orientation of the two principal meridians. A full discussion of this procedure is being deliberately postponed until after a consideration of simpler procedures which employ the Landolt ring.

Another solution to the problem is to assume that the principal meridians are vertical and horizontal, with the meridian of greatest refraction vertical and to proceed on this basis. Fortunately, this assumption is usually correct. Once this assumption is made, the test objects and testing procedures are the same as when the positions of the two principal meridians are actually known.

## MEASUREMENT OF ACUITY WHEN THE POSITIONS OF THE TWO PRINCIPAL MERIDIANS ARE KNOWN

If the principal meridians are known in advance one can orient the targets to any desired relation with the principal meridians. In order to interpret the results it is necessary to know in each situation whether the measurement obtained represents a measure of blurredness in one of the principal meridians or some intermediate value.

In the case of the checkerboard pattern (Figure 1E), the measure obtained represents the acuity at the more blurred of the two principal meridians when the rows of squares are parallel to the principal meridians. And, when the rows of diamonds are parallel to the principal meridians, the measure obtained represents the acuity in the less blurred of the two principal meridians. The principles involved are illustrated in Figure 8. If a chart similar to Figure 8A is placed at 20 feet and if the smallest checkerboard subtends 5 minutes of arc, the effect obtained in Figure 8C is equivalent to what is seen by an emmetropic eye when a +0.37 D. S. $\bigcirc$ +1.50 D. C. $\times$ 90 and a 3 mm. artificial pupil are placed in the primary principal plane. In the case of Figure 8D, the axis of the cylinder is rotated to the 45° meridian. It is obvious in the case of Figure 8C that the squares fuse more or less to give a fairly uniform distribution of intensity in the third checkerboard from the top. It is to be noted that articulations of high contrast reappear in the smaller checkerboards. It is important therefore to start with large checkerboards and proceed to smaller checkerboards until the first one is found

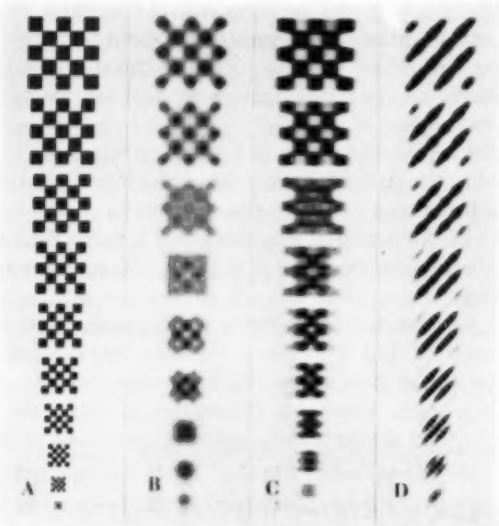


Fig. 8. Fig. 8A represents a chart placed at 6M. from the eye with the smallest checkerboard subtending a visual angle of 5 minutes. 8B, C, and D represent appearances to an emmetropic eye looking at the chart through a 3 mm. artificial pupil in the primary focal plane and a +1.50 D.S. in the case of B, a +0.37 D.S. ⌒ +1.50 D.C. axis 90 in the case of C, and a +0.37 D.S. ⌒ +1.50 D.C. axis 135.

at which the pattern becomes more or less uniform. Otherwise there is some danger of obtaining a false rating of visual acuity. In the case of a Bausch & Lomb pattern (Figure 2), the criterion is the inability to differentiate between the checkerboard and the squares which are filled with small dots.

In the case of Figure 8D, the rows of diamonds become transformed into black lines and these can be differentiated from the white spaces between them down to the second checkerboard from the bottom of the chart.

A single bar (Figure 1B) can be used with its long dimension parallel to either of the two principal meridians and by varying the width, thresholds can be determined which will provide measures of the degree of blurredness in each of the two principal meridians. In a similar manner a pair of bars or a grating can be used to determine the minimum separable which will constitute measures of the acuity for the two principal meridians.

A visual acuity pattern involving two or more bars presents a special problem for the measurement of visual acuity without glasses in

which the image of a point source is either an ellipse or circle having a uniform distribution of intensity. The problem is illustrated in Figure 9, involving two bar and three bar patterns with three sizes each.

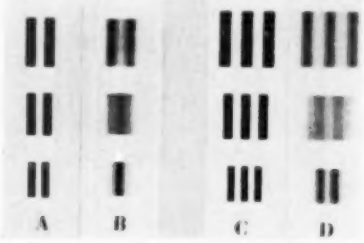


Fig. 9. Figs. 9A and 9C represent charts placed at 6M. from the eye with each of the bars in the bottom sets of bars subtending a horizontal visual angle of 5 minutes. Fig. 9B represents the appearance of the chart in Fig. 9A to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +1.62 D.C. axis 90 placed in the primary focal plane. Fig. 9D represents the appearance of the chart in Fig. 9C to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +0.12 D.S. ⊃ +1.62 D.C. axis 90 placed in the primary focal plane.

In Figure 9B the upper pair of bars is seen blurred but is essentially the same as the original pattern. The middle pair of bars gives a more or less uniform distribution of intensity. The effect would be even more uniform if the pattern were slightly smaller, but even at best the image is broken up into a series of dark and bright bands. These bands are consistent with simple blur circle theory. As the size of target is decreased there emerges from this approximate state of fusion a dark bar at the center of the pattern with faint dark bars to the right and left of it. A similar situation exists in the case of Figures 9C and 9D. The three bars undergo a transition through a state of more or less fusion and emerge into a pattern with two distinct black bars flanked by two fainter dark bars.

Similar effects are obtained with the concentric ring target as shown in Figure 7B. Various patterns of high contrast emerge and disappear throughout the transition from the largest target to the smallest. In order to make use of such a pattern, it is necessary to arrange the procedure so that in going from larger to smaller targets the first fusion point is the one selected as the measure of acuity.

This persistence of detectable articulations in patterns smaller than the "first fusion" size could be avoided by using test objects which are blurred at the outset. The desired effect could be obtained by using black test objects on milk glass illuminated from behind and placing a sheet of ground glass a short distance in front of them. Another solution to the problem would be to use a series of bars of different width to obtain

the equivalent of a graded distribution of intensity. Figure 10 illustrates the principle involved. Figure 10B represents a suitable substitute for Figure 10A. Each of the wide black bars is flanked by two smaller black bars and the wide white bar at the center is similarly flanked by

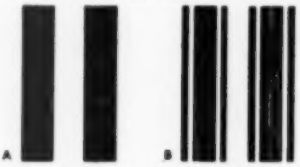


Fig. 10. Fig. 10B represents a substitute for Fig. 10A which achieves an effect comparable to blurring the bars in Fig. 10A in a horizontal direction. This constitutes one method of combating the supernumerary effects such as are observed in Figs. 9B and 9D.

two smaller white bars. This same principle could be carried out to as fine a gradation as desired. Black and white bands of this sort could be easily reproduced and would be superior in this respect to targets involving a photographic reproduction of a blurred pattern.

In measuring visual acuity without glasses, it is of course desirable to use either the natural pupil or a round artificial pupil. But, for the purpose of demonstrating the avoidance of persistent articulations, an artificial pupil having the shape shown in Figure 11 could be used in

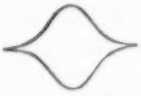

Fig. 11. An artificial pupil which can be used as a substitute for the natural pupils which is round to eliminate the supernumerary effects such as are obtained in the case of Figs. 9B and 9D.

conjunction with a two bar or three bar pattern with the line connecting the two spurs of the artificial pupil perpendicular to the direction of the bars.

When the position of the principal meridians is known, a test can be worked out with the Landolt ring employing four positions of the gaps which correspond to the principal meridians. On the assumption that accommodation remains constant, one can design a test employing this target which will provide a measure of acuity in either of the principal meridians and which will prevent a subject from improving his score by falsifying his report of what he sees. Targets of different size are used. For each size target, the target is presented a number of times with the gap being varied from one presentation to the next. The frequency of presentations is the same for all positions. The subject is instructed to report the position in which the gap is seen or to guess the

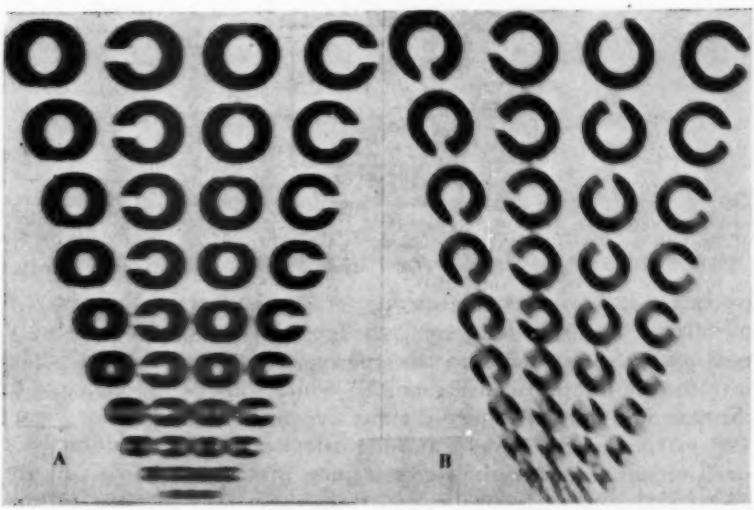


Fig. 12. Fig. 12A represents the appearance of the chart in Fig. 4A to an emmetropic eye looking at the chart through a 3 mm. artificial pupil and a +0.37 D.S. ⊃ +1.50 D.C. axis 90. Fig. 12B represents the appearance of the same chart observed under the same conditions except that the cylinder axis is shifted to 135.

position when he cannot see it. The principles involved are illustrated in Figure 12A. If a chart similar to one shown in Figure 4A is placed at 20 feet with the smallest ring subtending 5 minutes of arc at the eye; and, if the chart is viewed by an emmetropic eye through a +0.37 D. S. ⊃ +1.50 D. C. × 90 and a 3 mm. pupil, the effect obtained is equivalent to that shown in Figure 12A.

There is a size of test object at which the chance of a correct guess is one out of four. For a size at which the up and down positions can be seen but the right and left positions have to be guessed, the chance of a correct guess of these positions is still one out of four.* The size frequency graph which would be obtained in this case would be similar to that shown in Figure 13. If four out of 10 guesses were used as a criterion for passing, the measure would represent a measure of the acuity of the less blurred of the two principal meridians; but, if eight out of 10 were used, it would be a measure of acuity for the more blurred meridian.

One can also use the Landolt broken ring to obtain a score which

*If the subject catches on to the fact that he is definitely seeing breaks in the up and down positions, he might deduce that the break must be to the right or left when he cannot see it, and hence the chance of a correct guess would be one out of two.

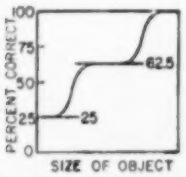


Fig. 13. Size-frequency graph for the judgment of the position of the gap in a Landolt broken ring which is presented with the gap in four positions corresponding to the principal meridians. The graph shows the percentage of correct answers for rings of different size and illustrates the case of an astigmatic eye.

represents approximately an average of the acuities in the principal meridians. This is done by using the four oblique positions instead of positions that correspond to the principal meridians. The principles involved are illustrated in Figure 12B which shows the appearance of the chart in Figure 4A observed under the same condition as for Figure 12A except that the cylinder axis is rotated to the 135° position. For small objects the chance of a correct guess is one out of four. As the size increases, the chance of a correct guess gradually increases to four out of four. The size-frequency graph would be expected to have the same form as that illustrated in Figure 5. A passing criterion of six correct answers out of 10 would give a measure which would be approximately an average for the two principal meridians.

### USE OF THE LANDOLT BROKEN RING WHEN THE PRINCIPAL MERIDIANS ARE NOT KNOWN

It is possible to design a test which employs eight positions of the broken ring instead of four and which makes it unnecessary to pay attention to the position of the gaps with respect to the principal meridians. Let us assume that by chance two pairs of these positions correspond to the principal meridians. There is a level of size of test object below which the chance of guessing a correct answer is one out of eight. At a slightly higher level the subject can detect the gap when in one meridian, and hence he always gets two positions correct and his chance of guessing any other position correct is one out of eight. The expected percentage of correct answers would be 34.37 per cent. At a still higher level he would be able to detect gaps in the most blurred meridian and the oblique meridians, but not in the least blurred meridian. He would always get six positions correct, but his chance of guessing one of the other positions would still be one out of eight. At a still higher level he would be able to get all positions. The expected size-frequency graph is shown in Figure 14A.

Theoretically a criterion of two out of 10 would give a measure

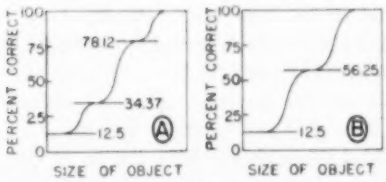


Fig. 14. Size-frequency graphs for Landolt broken ring with the gaps in eight positions. The graph in Fig. 14A illustrates the case of an astigmatic eye with two pairs of gaps falling at the principal meridians. Fig. 14B illustrates the case of an astigmatic eye with each principal meridian falling midway between two pairs of gaps.

representing the least blurred meridian, and nine out of 10 should give a measure representing the most blurred meridian. The criterion of six out of 10 represents a measure intermediate to the measures for the two principal meridians.

If by chance the principal meridians should fall at positions intermediate to the gap positions, the size-frequency graph would have the form shown in Figure 14B. For small sizes the chance of guessing the position would be one out of eight. As the size increases a level would be reached at which four of the eight positions could be seen, but the other four positions would have to be guessed with the chance of a correct guess being one out of eight. The expected percentage of correct guesses would be 56.25. Finally a level would be reached at which all positions could be seen. The criterion of six out of 10 falls close to the plateau. The measure would not be precise but at least would be close to that obtained when two pairs of gaps fall at the principal meridians.

The Landolt ring is used instead of a straight line with a gap in it because in the case of the ring, detection of the position of the gap can be used as a criterion of visibility. The substitution of the ring for the bar introduces certain complications, however. As shown in Figure 4B, the images of the opposite sides of the ring overlap before the position of the gap becomes indetectable, and the ring is no longer perceived as a ring. This particular difficulty could be overcome by using a ring of different dimensions.

However, even if a straight bar with a gap were used, the problem of detecting the gap would still not be an all-or-none affair comparable to the threshold for a small disc or a single bar. Indentations would occur at the gap which would betray it, even though a dark isthmus might extend across the gap. At this point skill in the interpretation of blurred imagery enters into the picture.

## SUMMARY AND CONCLUSIONS

There are many other types of test objects which might be inves-

tigated but the ones which have been considered suffice to illustrate the problems involved in the design of test objects and procedures for measuring visual acuity without glasses.

This analysis of the problem is based upon simple blur circle theory which assumes that the light in the image of a point source is uniformly distributed throughout the circle or ellipse which constitutes the image. This type of investigation should be supplemented by an experimental determination of the size-frequency graphs using a subject with an emmetropic homatropinized eye and an artificial pupil and throwing the eye out of fucus with spheres and cylinders. One could carry the investigation further by using a group of subjects with different amounts of refractive error and determine the correlation between refractive error and visual acuity provided accommodation and pupil size were controlled.

There are a few basic conclusions that can be drawn from this analysis. In the measurement of visual acuity without glasses, it is necessary to distinguish between targets which depend upon the interpretation of blurred imagery or recognition of form, and targets which involve an all-or-none perception of a line, point, or gap. Actually the fundamental distinction is not between types of tagets but between types of thresholds. A black square on white background, for example, can be used for the measurement of both types of thresholds. There is a size at which the square is just visible, and another size at which it can be differentiated from a disc. The choice of one threshold as opposed to the other depends upon whether the examiner wants to measure the importance of skill in interpreting blurred imagery, or the amount of blurredness *per se*.

A second major conclusion is that the optical image formed on the retina by such stimulus patterns as gratings, double bars, double rings, and checkerboards become complicated with supernumerary effects depending upon the peculiar manner in which the blur circles and ellipses overlap. Several methods have been suggested for overcoming this difficulty but probably the simplest solution is to avoid patterns of this sort and stick to the use of single lines and points, that is, if the purpose of the measurement is to determine the extent to which the eye is out of focus.

The third conclusion concerns the comparative values of lines and points for the measurement of visual acuity. A point can be used only for the purpose of measuring the blurredness in the less blurred of the two principal meridians of an astigmatic eye whereas a line can be used for the measurement of blurredness in any meridian. This means that in

some situations a point may be satisfactory but in others a line would have to be used. Techniques have been outlined in the paper for the use of a line with or without foreknowledge of the position of the principal meridians.

ACKNOWLEDGMENT

Appreciation is expressed to the Ohio State University Department of Photography for assistance and cooperation in connection with the illustrations presented in this paper.

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[2]E. S. Lamar, S. Hecht, S. Schlaer, and C. D. Hendley, Size, Shape, and Contrast in Detection of Targets by Daylight Vision, I. Data and Analytical Description., J.O.S.A., 37, 531-545 (1947).
[3]G. A. Fry, The Relation of the Configuration of a Brightness Contrast Border to Its Visibility, J.O.S.A., 37, 166-175 (1947).

## BOOK NOTICE

MECHANICAL AND OPHTHALMIC OPTICS LABORATORY MANUAL. Henry A. Knoll, Los Angeles College of Optometry, Los Angeles, California, paper cover, plastic spiral binding, 8½" x 11", 75 pages, $2.25, 1952.

As the title implies, this is a manual for use by students taking a laboratory course in mechanical and ophthalmic optics. It consists of a series of thirty exercises with instructions and data sheets.

Instructions are very brief, but text-book references are cited for detailed descriptions of each laboratory operation. The operations include use of all types of lens measuring instruments: prescription glazing of metal and plastic frames and mountings; identification, specification, and measurement of various ophthalmic products; demonstrations of lens and frame fabrication; practice in prescription cost analysis and organization of laboratory processes; and adaptation of spectacles to facial requirements.

The manual has a very specific instructional purpose, and hence has only limited value as a general reference source. It would be very useful however to anyone wishing to follow a well planned series of exercises to develop proficiency in ophthalmic laboratory work.

H. W. HOFSTETTER

# A NOTE ON COLOR VISION*

Joseph I. Pascal†
New York, New York

The perception of color embraces three qualities, each of which has an objective phase and a subjective counterpart. Thus, red is distinguished from blue, because objectively there is a difference in wave length between the two light stimuli. This is the reason generally stated in books on the subject. The subjective counterpart to differences in wave length is a difference in tone or hue. The second quality on the objective side is purity, i.e., the degree to which the exciting light waves consist of only one or a very narrow band of adjacent wave lengths. An admixture of white lessens its purity. On the subjective side this determines the degree of saturation of the color. The third quality is brightness, objective brightness or luminance and subjective brightness. This is more of a quantitative feature, depending partly on the amount of luminous energy striking the retina. It is only partly quantitative because for the same amount of energy, the medium waves (the greenish yellow of about 555 millimicrons in the light adapted eye, and of about 510 millimicrons in the dark adapted eye) produce a stronger impact on the visual mechanism and appear brighter than the shorter and longer waves at each end of the spectrum.

The first quality referring to wave length and hue needs a bit of clarification. Our present concept of light is that it is both a particle and a wave. That is, it consists of energy particles, the light quanta or photons which display the characteristics of electro-magnetic waves, i.e., they have a wave length and a wave (vibration) frequency. In phenomena where the particle nature of light is evident its wave nature is not evident, and in phenomena where its wave nature makes itself manifest, its particle nature is not evident. One may thus think of it as if it were a coin with two faces. When you look on the front side you see, say, the face of a president, on the back side you see, say, a public building. They are two phases of one and the same coin.

Now a wave has several characteristics; the two that concern us here are the wave length and the wave frequency. These have a reciprocal relation, the short waves have a high frequency, the long waves have a low frequency. This of course follows from the fact that all light waves

*Submitted on May 31, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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travel in a vacuum (practically the same in air) with a uniform speed. The short waves must therefore have a correspondingly greater number to cover the same distance in the same time as the long waves. Thus the vibration frequency of the violet of 400 millimicrons must be twice as great as the vibration frequency of the long waves of the extreme red of 800 millimicrons.

Wave frequency is a more fundamental attribute of electro-magnetic waves than wave length. Thus when light travels in a dense medium, say, water whose index is 4/3, its speed is 3/4 of its speed in air. The reduction in speed is due to a shortening of the wave length, the frequency remains the same. The light waves as they pass through water are shortened to ¾ of their length in air.

Thus light energy as it travels through different media maintains the same vibration frequency as in air for each of its component elements. It undergoes a corresponding shortening of the various wave length. The specific hue of a color is due to its frequency and not to its wave length. Say a disc which in air emits waves of, say, 600 millimicrons, appears red. When this disc is placed in water and the eye is placed under water, the disc will still appear red although now the waves reaching the eye have a length of 450 millimicrons, corresponding to blue-violet.

In fact, when we say that the eye is sensitive to waves whose length runs from about 400 millimicrons to about 800 millimicrons (taking the extremes of the spectrum) we should modify the statement. The 400 to 800 millimicron waves in air in order to reach the retina must pass through the ocular media with an average index of 4/3. This shortens the waves so that when they strike the retina their length runs from about 300 to 600 millimicrons. Of course their *frequencies* as they strike the retina are the same as their frequencies in air.

If differences in hue discrimination were due to differences in wave length, then the work of Granit and others who studied the action currents of individual nerve fibers in an excised eye from which the ocular media were removed would not be directly applicable to an eye with the ocular media intact. But as the frequencies remain the same in air as when passing through the ocular media the findings are fully applicable. Once this is understood, it is more convenient to refer to wave length rather than to frequency in studying color phenomena. Wave frequencies run into astronomical figures, e.g., the frequency of the short ultra-violet runs to about $10^{15}$ vibrations per second.

SUMMARY

The three qualities of a color have each an objective phase and a subjective counterpart. These are, as generally given, wave length and

hue, purity and saturation, luminance and brightness. The wave length and hue concept is only a convenient way of expressing this relation, since fundamentally, it is the difference in wave (vibration) frequency which determines the hue and not the difference in wave length. Several related points on light and color vision are also mentioned.

37 WEST 97TH STREET,
NEW YORK 25, NEW YORK

## BOOK NOTICE

SELECTED STUDIES IN VISUAL OPTICS. Joseph I. Pascal, O.D., M.D., Published by the C. V. Mosby Company, St. Louis, Mo. 800 pages. Illustrated. Cloth. $12.50. 1952.

This is an unusual book in that it is devoted to filling in the gaps and making more understandable much of the theoretical material so frequently presented in other texts on refraction, optics and allied subjects. It is a highly practical and functional book in which the various procedures for determining and interpreting the anomalies of vision are discused concisely and clearly.

Pascal with his rich background accumulated in the course of some 40 years of teaching presents some old material in a way that is more easily grasped and absorbed by both students and practitioners. He also introduces a number of new ideas, new methods, new applications, simplified formulas, memory aids for things easily forgotten, schematic and graphic presentation of things that are otherwise but hazy ideas.

The first five chapters are concerned with lenses and prisms—their physical and optical properties. Chapters 6 and 7 discuss the physiological and optical aspects of refraction while Chapters 29, 30, and 31 present many helpful points on the use of the cross cylinder tests. Chapters 11 through 14 are devoted to retinoscopy—a non-geometric exposition of the optical theory, a review of the fundamentals of dynamic retinoscopy, principles and application of cylinder retinoscopy, and specialized techniques in the practice of retinoscopy. There are two brief chapters (8 and 34) on orthoptics and vision training. It is not clear why these chapters, as well as other chapters on related subjects, are separated in the book. Other chapters—there are 46 in all—include such interesting and important matters as: Pascal's unique "Dam" formula which makes easy many otherwise complicated optical calculations; various aspects of lens effectivity; axes and angles of the eye; several notes and amplifications on geometric optics, image formation in the eye, reflection, refraction, thick lenses and lens combinations, lens forms, and optical oddities of contact lenses. In the field of binocular vision and ocular motility, there are meaty chapters on the mechanism and measurement of convergence, binocular duction tests and their significance, calculating stereoscopic vergence, a graphic study of the ocular muscle, and finally a most interesting presentation of a difficult subject, the charting of the diplopia field, made easy by Pascal's use of his "Benzene Ring Schema."

The text is aided greatly by a large number of illustrations consisting of excellent diagrams, and drawings. It will prove to be a helpful reference book for practitioners, teachers and students.

ROBERT E. BANNON.

# LEONARDO AND CONTACT LENSES*

Henry W. Hofstetter†
Division of Optometry, Indiana University
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and
Robert Graham‡
Los Angeles College of Optometry
Los Angeles, California

This year* being the 500th anniversary of the birth of Leonardo da Vinci (1452-1519), it is timely to note his extensive studies in optics and vision, filling many of the 7,000 pages of notes which are preserved.§ Leonardo filled an entire notebook of 20 pages with studies of the eye, the Manuscript D (Codex of the Eye) in the Institute de France, Paris. In it we find a set of illustrations developing, surprisingly, the principle of the contact lens.

This may well be the earliest reference to contact lenses. In various ophthalmic publications the earliest design of the contact lens has been credited successively to John F. Herschel (1827) and Thomas Young (1801).[1] More recently Alpern[2] has also called attention to a contact lens experiment by Descartes (1637). Leonardo da Vinci's design was recorded in about 1508.

In two separate instances Leonardo employed the optical method of immersing the eye (or eyes) in a lens containing water. The first instance was in connection with a rather complicated experiment illustrated in the two sketches in Figure 1. Part of the translation (by Ferrero[3]) of the related legend reads as follows:

> "In order to make the experiment on how the visual sense gets the image of the objects from its instrument—the eye—a ball of glass will be made with a diameter of five-eighths of a *braccia* (yard); from one side of it a piece should be cut out so that a face might be put into it to the ears. Then let us fix to the bottom of it a box, one-third of a *braccia* in size; with a hole in the middle which is four times larger than the pupil of the eye—or approxi-

*Submitted on July 23, 1952, for publication in the January, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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‡Optometrist. Member of faculty. Fellow, American Academy of Optometry.
§Appreciation is expressed to Elmer Belt, M.D., for the use of his Library of Vinciana, to Nino Ferrero, M.D., for the loan of his translation manuscript, and especially to Mrs. Kate Steinitz, Librarian, for her personal assistance and guidance.

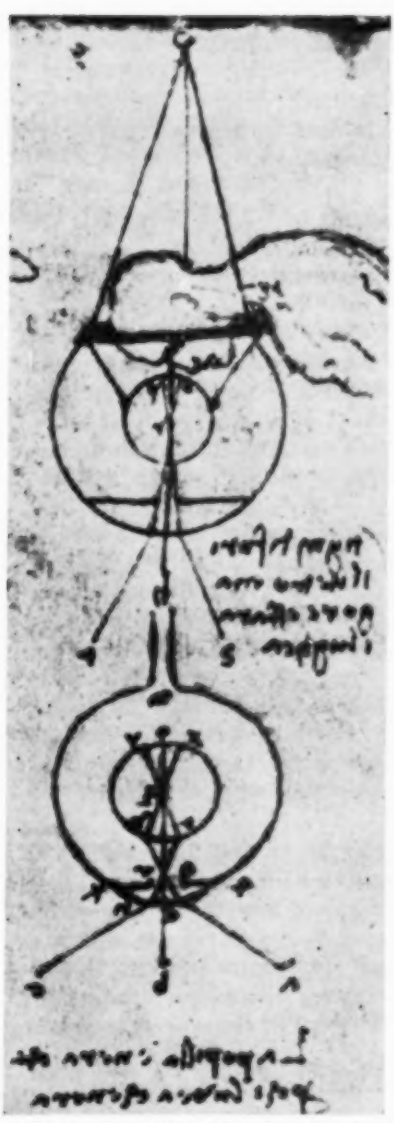

Fig. 1. From Folio 3 V. The legend is in mirror writing, as Leonardo was wont to record much of his work. Photographic copy courtesy Elmer Belt Library of Vinciana.

Fig. 2. From Folio 7 V. Writing mirrored as in Fig. 1. Photographic copy courtesy Elmer Belt Library of Vinciana. Fig. 1 on left, Fig. 2 on right above.

mately so—it does not matter. Beside this, let us make a ball of thin glass with a diameter of one-sixth of a *braccia* and let us fill everything with clear lukewarm water. Then put your face into the water and look into the ball and observe: you will see that this instrument sends out the images of "s-t" to your eye, as the eye sends them to the visual sense."

In the second instance Leonardo shows less formality in his discourse, being more concerned with the presentation of a design than in developing a theme or making a fundamental inquiry. Characteristic of marginal notes are the smaller, sketchier drawings and the discontinuities in sentence structure, illustrated in Figure 2 and translated as follows by Ferrero.[4]

(Below first drawing and around second) "Break a ball of glass and with the convex part of it make a mask full of water and you will see that it is true what is promised here below. And if you want to look with only one eye do use the body of a little or a big ampule, etc."

(Around third drawing) "Here the air becomes a concave mirror."

(Inside third drawing) "Luke-warm water."

(Inside fourth drawing) "Water."

(Around fifth drawing) "Here the air becomes a convex mirror."

(Inside fifth drawing) "Let *r t* be too large for the pupil."

(Below fifth drawing) "Make little round ampules like this" (drawing).

"Then cut them like glasses are cut with a hot piece of iron and make shells of half sphere like this (drawing). Then use them for your glasses full of water like this (drawing) and fill only one with water."

The three very small drawings in the second-last and fourth-last lines of the legend in Figure 2 may be interpreted to be simple freehand illustrations of one contact lens by itself and two in situ, i.e. in contact with the eye, the inside curve appearing to be the cornea in each illustration. Another interpretation might be that the last two of these three small drawings are each an assembly of two pieces of glass with water inside. However, their vertical instead of horizontal orientation contraindicates this, as does the loosely woven but nevertheless persistent theme in this set of marginal notes, that of water in contact with the eye.

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## BOOKS RECEIVED

TRANSACTIONS OF THE INTERNATIONAL OPTICAL CONGRESS OF 1951. (London.) Published by the British Optical Association, 65 Brook Street, London, W. 1, England. 493 pages. Illustrated. Paper covers, $6.50. Cloth, $9.00. 1952.

OPHTHALMIC PATHOLOGY. AN ATLAS AND TEXTBOOK. Jonas S. Friedenwald, M.D., Helenor Campbell Wilder, M.D., *et al*. Published under the joint sponsorship of the American Academy of Ophthalmology and Otolaryngology and the Armed Forces Institute of Pathology. Published by the W. B. Saunders Company, Philadelphia. 489 pages. Illustrated. Cloth. $18.00. 1952.

SURGERY OF THE EYE. Third Edition. Meyer Wiener, M.D., revised by Harold G. Scheie, M.D. Published by Grune & Stratton, Inc., New York, New York. 449 pages. Illustrated. Cloth. $15.00. 1952.

PHYSIOLOGY OF THE EYE. Volume Two. VISION. Arthur Linksz, M.D. Published by Grune & Stratton, Inc., New York, New York. 869 pages. Illustrated. Cloth. $19.00. 1952.

DIRECTORY AND HANDBOOK OF THE SCIENTIFIC INSTRUMENT MANUFACTURERS ASSOCIATION. 1952. (Great Britain.) Published by the Association, at 20, Queen Anne St., London, W. 1, England. 251 pages. Illustrated. Cloth. 1952.

INTRODUCTION TO PHYSIOLOGICAL OPTICS. Armin Von Tschermak-Seysenegg, of the University of Munich. Translated by Paul Boeder, Ph.D. Director, Bureau of Visual Science, American Optical Company, Southbridge, Mass. Translation sponsored by the Committee on Optics and Visual Physiology, of the Section on Ophthalmology, American Medical Association; the American Ophthalmological Society, and the American Academy of Ophthalmology and Otolaryngology. Published by Charles C. Thomas, Publisher, Springfield, Illinois. 299 pages. Illustrated. Cloth. 1952.

AMERICAN JOURNAL OF OPTOMETRY
*and* ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 30 January, 1953 No. 1

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Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $6.00 in Advance; Foreign, $6.50; Single Copies 60c.

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Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

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## THE NEED FOR STRONG STATE OPTOMETRIC ASSOCIATIONS

Optometric organizations almost everywhere are hard pressed for needed additional funds. Their activities are expanding and in these inflationary times, their costs of operation have risen so that project planning for the future is difficult. This is not a new condition, but one which has been affecting our associations ever since the end of World War II.

There is no one satisfactory solution to the problem. Some associations have met the condition in part by a substantial raise in dues. This has not solved the problem entirely, as where dues were markedly

increased, it sometimes became difficult to hold the membership to the prior high level.

Even if the raising of the dues produces additional revenue, this procedure may in the long run have an adverse effect. Our State optometric associations should represent strong numerical majorities of optometrists in their States to do the most effective work, and a drop in membership defeats this goal. Therefore, dues increases which caused a marked drop in membership should be studied and perhaps changed, even though the change might result in temporarily discarding some already approved plan or project which may seem immediately desirable.

In this period of sociological change through which all the healing arts professions are passing, the first requirement of optometry must be a country wide group of numerically strong State associations with a correspondingly strong American Optometric Association. Nothing must be permitted to interfere with this requirement. Academy members should assist other workers in achieving this condition. If association dues have been raised to a point where the available salesmanship of the association cannot hold the present members, and secure new ones, several suggestions may then be in order. First, a downward revision of the dues might be considered. Next, a study of the current program of the association should be made to be sure it is worthy of the time of members. And last, a better selling job is obviously required to hold old members and bring in new ones. In many associations all necessary projects may be well financed by an extended and well planned effort to expand the present membership rather than to further raise the annual dues.

CAREL C. KOCH

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## TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

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## REPORT OF THE 1952 ANNUAL CONVENTION OF THE ACADEMY

ROCHESTER, NEW YORK, DECEMBER 7 - 10, 1952

Virginia Huck
Editorial Assistant

The annual meeting of the American Academy of Optometry is now history, and will go on record as one of the finest meetings ever

held. The four-day program of technical papers left audience and speakers with a feeling of mutual satisfaction. Fellows who attended report they have never listened to as fine a technical program, and the speakers report they have never lectured to more appreciative audiences. Which is saying a great deal, considering the excellence which has characterized all past annual meetings of the Academy.

Credit for the success of the Rochester meeting is in large part due to Dr. Meredith W. Morgan, Jr., chairman of the papers and program committee, and to the section chairmen. Dr. Morgan expertly accomplished the near-impossible: he kept 29 technical papers going on schedule in a packed four-day session. The section chairmen held 30 hours of clinical discussions to augment the theoretical papers of the general sessions.

Attendance at the meeting represented a third of the Academy membership, with an exceptionally fine representation from Canada and from the British Chapter.

The flavor of the meeting was decidedly historical. Bausch & Lomb Optical Company was celebrating its coming 100th anniversary, and in keeping with this event, Dr. Morgan had asked four members of the Academy to present again historically significant papers they had given years ago before Academy groups. Three members gave their historical papers* in person: Dr. Charles Sheard, Dr. Glenn Fry, and Dr. Julius Neumueller. Dr. Edwin Forbes Tait's paper on "A Quantitative System of Dynamic Skiametry," was read for him by Dr. F. W. Sinn, Pennsylvania State College of Optometry, who had worked with Dr. Tait on many problems years ago.

DR. MEREDITH W. MORGAN, JR., ELECTED PRESIDENT OF ACADEMY

The American Academy of Optometry elected Dr. Meredith W. Morgan, Jr., noted optometric educator, lecturer, and author, its 1953 president. He succeeds Dr. Harold Simmerman, Wenonah, New Jersey.

Genial Dr. Morgan is well prepared for the responsibility of the Academy presidency. The 40-year old optometrist holds a Ph.D. in physiology from the University of California (1941), has risen from instructor to full professor of physiological optics and research associate at the School of Optometry, University of California from 1936 to the present. For years, he has contributed extensively to optometric literature, particularly in the field of motor aspects of binocular vision, and lectured at scientific meetings all over the country. In addition to research and teaching activities, Dr. Morgan practices optometry in Richmond, California, with his father.

*To be published in this Journal.

For the past two years, Dr. Morgan has served as chairman of the Academy program and papers committee, and done an outstanding job in this capacity. He also has served on the Editorial Council of the Academy, and is a member of many other optometric and scientific groups, including the Committee on Standards of the A. O. A., Sigma XI, A. A. A. S., and the Association for Research in Ophthalmology. He also belongs to several civic groups in his home city of El Cirroto, where he resides with his wife, Ida, and five-year-old daughter, Linda.

Academy Fellows know Dr. Morgan as an educator of high ability, and an accomplished lecturer possessed of sound judgment and a good sense of humor and a most contagious, hearty laugh. He was born in Kingman, Arizona, March 22, 1912, attended high school in Richmond, California, received an A.B. and M.A. at the University of California in 1934 and 1939, respectively.

President Morgan is now busy making committee appointments for 1953, and these will be announced in a coming issue of the Journal.

OFFICERS AND EXECUTIVE COUNCIL FOR 1953

Officers and Executive Council of the Academy who will serve this year are as follows: Dr. Morgan, president; Dr. John D. Perry, Winston-Salem, North Carolina, vice president; Dr. Carel C. Koch, Minneapolis, Minnesota, secretary-treasurer; Dr. Harold Simmerman, Wenonah, New Jersey, past president. The Executive Council: The officers and Dr. Lawrence Fitch, Pennsylvania, State College of Optometry, Philadelphia, Pennsylvania; Dr. Donald A. Springer, Anniston, Alabama; Dr. R. W. Tubesing, Richmond, Indiana, Dr. Ralph Wick, Rapid City, South Dakota, and Dr. D. G. Hummel, Cleveland, Ohio, ex officio member.

EXECUTIVE COUNCIL ACTION

The Executive Council of the Academy took the following action at the 1952 annual meeting:

Voted to have the Manual of Instructions for applicants to Academy Fellowship rewritten in simpler form. Admittance rules and procedures were not changed in any way, however. President Morgan appointed past president Dr. Harold Simmerman, Wenonah, New Jersey, the new chairman of the Committee on Admittance, and the rewriting of the Manual will be carried on under his supervision.

BANQUET

Dr. Brian O'Brien, one of the nation's most noted scientists, was the guest speaker at the annual roundtable formal banquet held in the Seneca Hotel, Monday evening, December 8, 1952. The 54-year-old

physicist delivered one of the most technical, yet most clearly presented, papers the Academy has heard, on "Vision and Resolution in the Central Retina." In this paper, considerable new work was presented.

Dr. O'Brien has spent a lifetime of research and teaching in the field of physics and physiological optics. He received his Ph.D. in physics in 1922, at Yale University, then joined the research department of Westinghouse Electric Company for a year, and subsequently did research work in physiological optics at the University of Rochester, Rochester, New York, where he became, and is now, director of the Institute of Optics and research professor in physiological optics. Dr. O'Brien has also spent a great deal of time working on national defense problems connected with vision and was awarded a medal for his work with the National Research Council in this field. He has contributed extensively to the literature in physics and physiological optics, including papers on flicker phenomenon in vision, and retinal structure and visual problems. He is a member of the Optical Society of America, the Institute of Electrical Engineers, and several other societies in allied fields.

Other distinguished guests at the Academy banquet were Herbert Eisenhart, chairman of the board, J. F. Taylor, president, and Carl Bausch, all of Bausch & Lomb Optical Company. Mr. Eisenhart gave a short talk on the company's history and future plans, in response to the Academy's congratulations on B & L's coming 100th anniversary.

At the head table also were Academy Fellows Dr. Norman B. Hays, vice president of the A. O. A., Dr. Arthur P. Wheelock, past chairman of the Committee on Admittance, and of course, Dr. Harold Simmerman, outgoing president and presiding officer, and Dr. Morgan, 1953 president.

During banquet proceedings, the Academy, in appreciation of his outstanding and warm leadership as Academy president during the past two years, presented Dr. Simmerman with a sterling silver cream and sugar set.

A new chapter was also officially welcomed into the Academy at the banquet. A charter granted in 1952 to the Texas Chapter was presented to Dr. Bernard Mazow, of Houston, who accepted it on behalf of the chapter.

CONVENTION SIDELIGHTS

The interim meeting of the board of trustees of the American Optometric Association was held concurrently with the Academy meeting in Rochester. The Executive Council of the Academy met with this group of A. O. A. officials and discussed mutual problems of optometry, including H. R. 6000, the bill which has caused a dilemma

which many believe must be solved as soon as possible. The Academy Fellows welcomed the opportunity of meeting with A. O. A. President James Wahl and his board and talking over those problems which need unified action on the part of all optometry.

Academy Fellows had the pleasure this year of not only seeing Lord Charnwood of London, England, but of meeting another British member of the Academy. Mr. Frank Dickinson, contact lens specialist from St. Annes-on-Sea, attended the meeting, and presented a paper on "The Contribution of Contact Lens Technique to Optometry." Mr. Dickinson, a most charming and versatile Britisher, spent part of his life practicing in Johannesburg, South Africa, does some free lance writing, plays the organ and directs a choir in his community. He has visited the United States several times before. On this trip, he visited friends in several American cities before returning to England on Christmas Eve.

Administrators of optometric schools and colleges were in Rochester in connection with the Academy meeting and held several conferences on school problems. Another group which met concurrently with the Academy was the Association of Military Optometrists of the United States which held its annual meeting in Rochester.

BAUSCH & LOMB TOUR

In connection with its coming 100th anniversary, Bausch & Lomb Optical Company sponsored two tours for Academy members, one through its glass plant, the other through its Navy Building and main plant. Officers of B & L accompanied the Fellows of the Academy and explained the various manufacturing processes. The trip through the glass plant was made early Tuesday morning, as this is the time the glass is poured. Fellows then returned to the Hotel Seneca for 9 A.M. section meetings, and the second tour was at noon the same day. The members of the Academy were guests of B & L at an excellent luncheon on this second trip.

NEW MEMBERS

The following new members of the Academy were approved for membership during the Rochester annual meeting. The Academy welcomes these new Fellows:

Dr. D. A. Ambrose, 613½ Monroe Street, Charleston, Illinois.

Mr. Arthur W. S. Armitage, 128 Regent Road, Leicester, England.

Dr. G. W. Clay, P. O. Box 660, Ardmore, Oklahoma.

Dr. John D. Engle, 603 Merkle Bank Building, Hazelton, Pennsylvania.

Dr. Edward Fisher, 711½ Market St., Parkersburg, West Virginia.

Dr. Paul H. Floyd, 330 Kirby Street, Lake Charles, Louisiana.

Mr. George H. Giles, Secretary, British Optical Association, 65 Brook Street, London, W. 1, England.

Dr. Jack T. Hobson, 1528 Stafford Avenue, Hayward, California.

Dr. Robert James Johnson, 401 Main St., Latrobe, Pennsylvania.

Dr. Walter W. Perrott, Jr., P. O. Box 1160, Columbus, Georgia.

Dr. Herman J. Raile, 330 Main Street, Menomonie, Wisconsin.

Dr. George W. Raulfs, Jr., Kiser-Allison Clinic, Emporia, Virginia.

Dr. Paul F. Shulman, Northern Illinois College of Optometry, 4170 Drexel Building, Chicago 15, Illinois.

1st Lt. Herbert L. Toms, MSC, U. S. Army Hospital, Camp Chaffee, Arkansas.

Dr. Howard Nelson Walton, Chicago College of Optometry, 2315 North Clark Street, Chicago 14, Illinois.

Dr. Gerald Westheimer, School of Optometry, The Ohio State University, Columbus 10, Ohio.

Dr. Walter S. Yasko, Northern Illinois College of Optometry, 4170 Drexel Boulevard, Chicago 15, Illinois.

CHAPTERS DISCUSS PROBLEMS AT SPECIAL LUNCHEON

Representatives from each of the Academy's 21 chapters, including the new Texas Chapter, attended a special chapter luncheon held Sunday, December 7, to discuss mutual problems. At the luncheon, these representatives were given the names of applicants from their area for Fellowship in the Academy, and plans made for aiding these applicants with their case reports, examinations, etc.

Dr. Lawrence Fitch, Pennsylvania State College of Optometry, arranged for and presided over the luncheon, in his capacity as chairman of the chapter committee.

1953, 1954 CONVENTION CITIES

The Academy will meet in Toronto, Ontario, Canada, in 1954, in response to an invitation from the Canadian Fellows. Chicago, Illinois had previously been chosen for 1953, in keeping with the tradition of meeting in this city every other year.

Serving on the Time and Place Committee at Rochester were Dr. Rudolph Ehrenberg, Granite Falls, Minnesota, chairman; Dr. Alfred Lit, New York, New York, and Dr. Eugene Freeman, Chicago, Illinois.

PAPERS PRESENTED

Dr. Meredith W. Morgan, Jr., and his papers and program committee presented one of the finest technical programs ever heard by the Academy, both in scientific value and excellence of presentation. A total of 29 papers were given by the following speakers:

Dr. Eugene Freeman, Dean, Chicago College of Optometry; Dr. K. Pestrecov, Scientific Bureau, B & L Optical Company; Dr. Mathew Alpern and Donald J. Benson, College of Optometry, Pacific University; Dr. Charles S. Bentley, Jr., and Dr. Donald A. Springer, Department of Psychology, Alabama Polytechnic Institute, Anniston, Alabama; Dr. Helen M. Robinson, Director, Reading Clinic, University of Chicago; Dr. Monroe J. Hirsch, Los Angeles College of Optometry; Mr. Frank Dickinson, St. Annes-on-Sea, England; Dr. Isidore Finkelstein, Columbia University; Dr. Gordon L. Walls, University of California.

Dr. Elwin Marg, Aero Medical Laboratory, Wright Patterson Air Force Base; Dr. Carl Shepard, Northern Illinois College of Optometry; Dr. George W. Knox, Ohio State University College of Optometry; Dr. Henry A. Knoll, Los Angeles College of Optometry; Dr. Joseph I. Pascal, New York, New York; Dr. Merrill J. Allen, School of Optometry, The Ohio State University; Dr. Gerald Westheimer, School of Optometry, The Ohio State University; Dr. Morton L. Abram, Chicago College of Optometry; Dr. Robert E. Bannon, Bureau of Visual Science, American Optical Company, Southbridge Massachusetts.

Dr. Charles Sheard, Los Angeles College of Optometry; Dr. Kenneth Zinnecker, Columbus, Ohio; Dr. Vincent Ellerbrock, The Ohio State University, College of Optometry; Dr. Wilson Sterling, Department of Ophthalmic Research and Development, B & L Optical Company; Dr. Ivan Epstein, Scientific Bureau, B & L Optical Company; Dr. Max Schapero and Morton S. Levy, Los Angeles College of Optometry; Dr. Julius Neumueller, Pennsylvania State College of Optometry; Dr. Glenn Fry, School of Optometry, The Ohio State University; Dr. Ernest Giglio, School of Optometry, Columbia University.

SECTION MEETINGS

Sections on aniseikonia, orthoptics, contact lenses, occupational vision and pathology were held from 9:00 A. M. to 11:00 A. M. each day, with the following Fellows in charge of these clinical programs: Aniseikonia, Dr. Leo F. Madigan, Boston, Massachusetts; Contact Lenses, Dr. John C. Neill, Pennsylvania State College of Optometry; Occupational Vision, Dr. Richard Feinberg, Northern Illinois College of Optometry; Orthoptics, Dr. J. Donald Kratz, Pennsylvania State College of Optometry; Pathology, Dr. William O. Vivian, Media, Pennsylvania.

Section speakers and their topics, not published before, were as follows:

*Contact Lens Section:* Dr. William W. Policoff, Wilkes-Barre, Pennsylvania, "A Molded Fluidless Scleral Type Contact Lens." Mr. Frank Dickinson, St. Annes-on-Sea, England, "Contact Lens Fitting Procedures in Great Britain." Jay M. Enoch, 2nd Lt., M.S.C., Ft. Knox, Kentucky, "Contact Lenses, Some Aspects of Visual Acuity and Photophobia." Dr. Russell Manwiller, Pennsylvania State College of Optometry, "Psychological Value of Cosmetic Contact Lenses in a Case of Phthisis Bulbi." Dr. William Feinbloom, New York City, "One More Year's Experience with Corneal Cap Lenses."

In addition to the above papers, round table discussions were held on contact lens fitting and contact lens teaching in optometry schools.

*Orthoptics Section:* Report of committee for evaluating diagnostic procedures used in heterotropias, Dr. T. W. Murroughs, chairman,

Northern Illinois College of Optometry; Dr. Alfred Rosenbloom, Northern Illinois College of Optometry, "Improved Reading—A Cooperative Undertaking." Dr. V. J. Ellerbrock, School of Optometry, The Ohio State University, "The Prescription of Stereoscopic Training by a Graphical Method." Dr. John Zettel, Jr., Cincinnati, Ohio, "A Possible Way to Extend the Use of the Perimeter."

*Aniseikonic Section:* Dr. Robert E. Bannon, American Optical Company, Southbridge, Massachusetts, "Progress of Aniseikonia and the Aniseikonic Forum." Dr. Benton C. Freeman, Allentown, Pennsylvania, "Aniseikonia in Cases Having Diplopia." Dr. Paul Connolly, Detroit, Michigan, "Unsuspected Aniseikonic Findings—A Case Report." Dr. A. A. Rosenbloom, Jr., Northern Illinois College of Optometry, "An Interim Report of a Study of Aniseikonia in Retarded Readers." Dr. Julius Neumueller, Pennsylvania State College of Optometry, "A Practitioner's View of Aniseikonia." Dr. Paul Haynes, "Problems and Difficulties in Obtaining Iseikonic Correcting Lenses."

A panel discussion on "Aniseikonia in the Colleges," was conducted with the following participants: Dr. Kenneth B. Stoddard, School of Optometry, University of California; Dr. Eugene Freeman, Dean, Chicago College of Optometry; Dr. Clifford L. Treleaven, School of Optometry, Columbia University; Dr. Henry W. Hofstetter, Indiana University Division of Optometry; Dr. Max Schapero, Los Angeles College of Optometry; Dr. Ralph H. Green, Dean, Massachusetts College of Optometry; Dr. A. A. Rosenbloom, Northern Illinois College of Optometry; Dr. Vincent J. Ellerbrock, School of Optometry, The Ohio State University; Dr. Walwyn S. Long, Ontario College of Optometry; and Dr. Mathew Alpern, Pacific University College of Optometry.

*Section on Occupational Vision:* Dr. E. H. Westland, chairman, A.O.A. committee on occupational vision, "The A.O.A. Committee on Occupational Vision—Its Contributions to Optometry." Dr. Herman Sager, Sperry Gyroscope Company, "A Ten Years' Report of a Vision Program." Dr. Harold C. Glover, Wright Patterson Air Force Base, "Applications of the Vertex Focometer." Mr. W. T. Cameron, Bureau of Industrial Safety and Visual Efficiency, American Optical Company, "Third Party Interest in Visual Care." Mr. Sylvester K. Guth, General Electric Company, "New Developments in Occupational Lighting and Seeing." Dr. Richard Feinberg, Northern Illinois College of Optometry, "Job Analyses by the Optometrist." Dr. N. Franklin Stump, occupational vision department, B & L, "Research in Occupational Seeing."

*Section on Pathology:* Dr. M. K. Greenspoon, "The Ocular Mani-

festations of Avitaminosis." Dr. Harry A. Jankiewicz, Los Angeles College of Optometry, "The Blue Sclerotics Syndrome in a Three Generation Pedigree." Dr. Henry J. Frank, "Ocular Hereditary Manifestations." Dr. William Walton, "Bio-Micropscopy of Certain Lenticular Disturbances." Dr. Sidney S. Haniford, "Visual Complications with Tumor of the Pituitary." Dr. Monroe J. Hirsch, Los Angeles College of Optometry, "Corneal Transplant."

## CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

### BINDING SERVICE

Suggestions to readers: If you have not already done so, why not send your twelve 1952 issues (Volume 29) of the *American Journal of Optometry* to the bookbinder? The scientific material in the Journal is essential for future reference, and should be kept in bound form for convenience and good care. The Journal is expressly prepared each month for binding; editorial matter is numbered consecutively from January through December, so when covers and advertising material are removed by the binder, and the issues are bound, the pages will run from 1 to 668.

The 1952 original papers in the Journal were carefully selected from many that were submitted, and represent the most advanced thinking of educational and clinical leaders in optometry. In book form they will be an asset to your library for a lifetime.

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### LIONS CLUB—EYE RESEARCH FUND IN OHIO

The Eye Research Board of Ohio, a Lions Club project, will have the aid of a research advisory committee when it begins to distribute funds raised during the past year for the purpose of financially aiding research in eye diseases that cause blindness. The following doctors will advise the Board on where to make grants-in-aid: Dr. Lorand V. Johnson, Western Reserve University, Cleveland, Ohio; Drs. Glenn Fry and

Arthur Culler, Ohio State University, and Dr. Donald Lyle of Cincinnati University. These three universities all have medical schools and research facilities and are close to eye pathology problems.

Fund raising for the Eye Research Board has been the number one welfare project of the Ohio Lions Clubs since October, 1951, when the board was organized. Distribution of funds will be under the general supervision of Mr. Everett R. Steece, Columbus, Ohio.

## PROFESSOR RALPH S. MINOR HONORED IN CALIFORNIA

Honor was paid to Professor Ralph S. Minor, dean emeritus of the School of Optometry, University of California, November 23, 1932, during the second annual optometry alumni reunion. A portrait of Dr. Minor, a gift of the alumni, was unveiled and dedicated. A noted California artist, now deceased, Hans Meyer-Kassel, painted the portrait, which will be hung in the new optometry library when alterations to the optometry building are completed, probably this month.

During the dedication ceremony, Dr. Frederick W. Hebbard, president of the Optometry Alumni Association, and Dr. Kenneth B. Stoddard, dean of the School of Optometry, made short speeches, and there was a program of choral music. With the exception of three years when he taught at the University of Neveda, Professor Minor was a faculty member at the University of California from 1903 to 1946, serving as Department head and later Dean of the School of Optometry until his retirement in 1946. He aided in establishing the original optometry curriculum in 1923, and directed its curriculum until he retired.

## EDUCATIONAL MEETINGS

The special visual problems of motorists were discussed at a Vision Conference sponsored by Iowa State College, December 15-17. Dr. Robert E. Bannon, Bureau of Visual Science, and Dr. O. W. Richards, Research Laboratory, American Optical Company, were speakers at the meeting. In addition to lecturing, Dr. Bannon conducted a special school for ophthalmic practitioners in aniseikonia and eikonometry.

The problems of aniseikonia, night myopia, licensing, screening tests, and driver improvement programs were discussed at the meeting which was sponsored by the engineering extension service, and put on by the department of psychology, and the Driving Research Laboratory of Iowa State Colege. The program was arranged by Dr. A. R. Lauer, of the Driving Research Laboratory.

* * * * *

An educational forum on contact lenses, sponsored by the Department of Education, California Optometric Association, was held at the

Los Angeles College of Optometry in November, 1952.

Over 100 doctors and students heard addresses by Dr. Charles Sheard, president, L. A. C. O., Drs. Max Schapero, Robert Levy, Louis M. Zabner, John R. Rottmann, Kevin M. Tuohy, Robert Graham, David E. Kraus, Adolphe Reader, Charles A. Pons, Sutter Kunkel, and Solon M. Braff.

Dr. James Gregg, president, Los Angeles County Optometric Association, presided.

NEWS BRIEFS

Organized optometry is 50 years old in New Jersey this year. Optometric groups in that state are planning many Golden Anniversary programs. The first celebration was a dinner in Newark, January 17. . . . Dr. Joseph I. Pascal, New York City, lectured before the Alpha Chapter of Omega Epsilon Phi fraternity recently at Columbia University. The talk was part of the fraternity's educational program for its members. . . . New appointments at Northern Illinois College of Optometry: Dr. Walker H. Matthews, Athens, Georgia was elected to the N. I. C. O. board of trustees. He is a Fellow of the American Academy of Optometry, and president of the College's Alumni Association. Dr. Frederick Kushner, associate professor of optometry, was named Dean of N. I. C. O. A native of Vienna, Austria, who graduated from the College in 1947, and stayed on to teach, Dr. Kushner has served consecutively as director of the optometry department of the college, assistant dean, and acting dean. He is also a member of the American Academy of Optometry. N. I. C. O. conferred the D.O.S. degree on Dr. Kushner in 1949. . . . Beta Sigma Kappa, international optometric honor society, contributed $50.00 toward the defrayal of the loss of text books suffered by Chicago College of Optometry students in a fire which destroyed the college dormitory, November 18, and burned the personal effects of many students. . . . Univis Lens Company, Dayton, Ohio announces the development of a new, precise fitting instrument called the Multimezur. According to Univis, this device "will enable the profession for the first time to make accurate and complete measure measurements for both single vision and multifocal lenses." It is made of lightweight plastic, and gives direct readings of D.B.L., semi-P.D. and aggregate P.D., segment height, inset, optical centering, and lens size for semi-rimless mountings. . . . Optometrists throughout the country are getting ready for "Save Your Vision Week," March 1-7, 1953. The Public Relations Department of the A.O.A. has already mailed publicity kits and instructions to its members.

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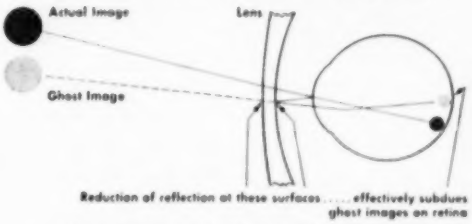


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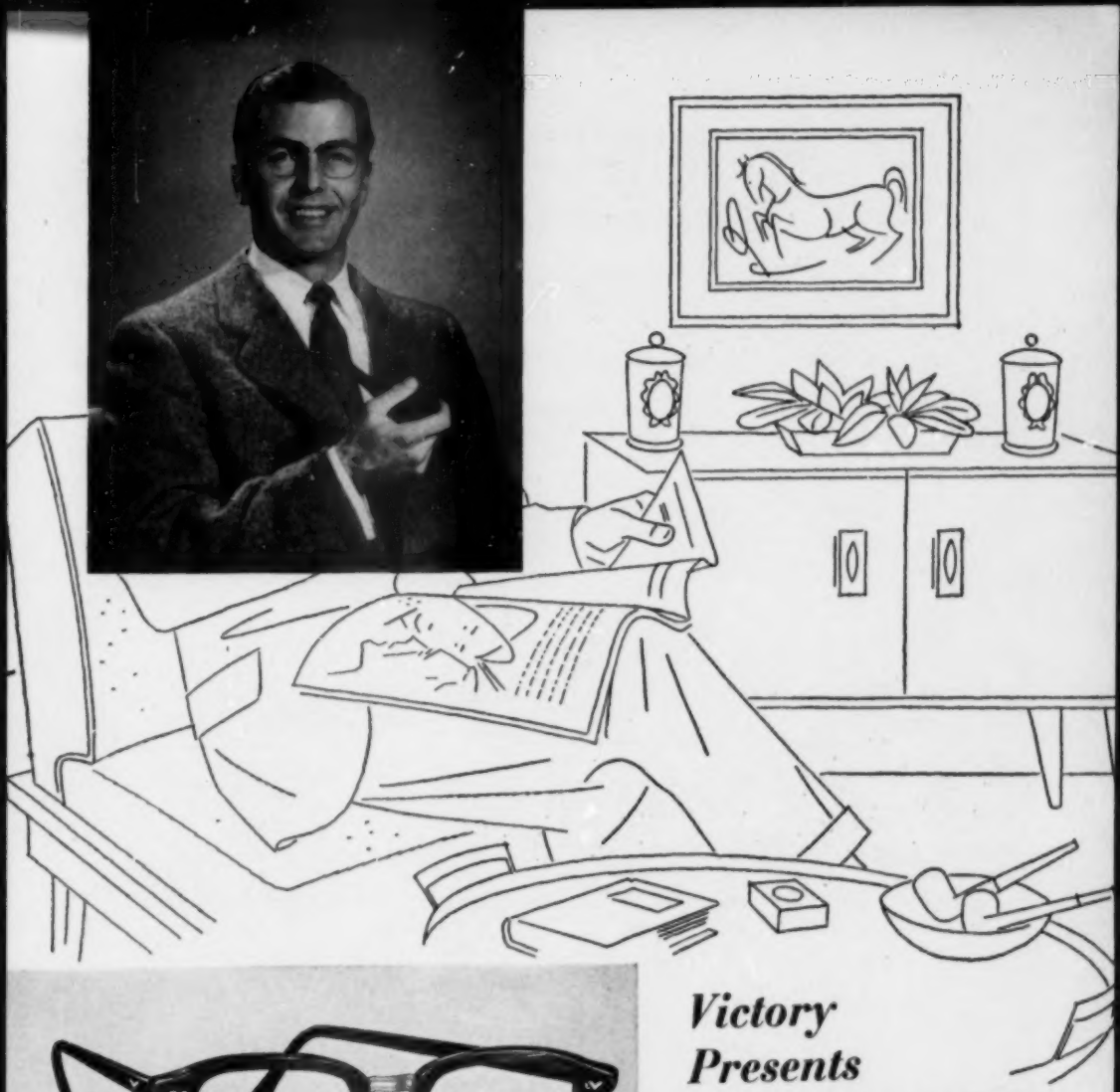

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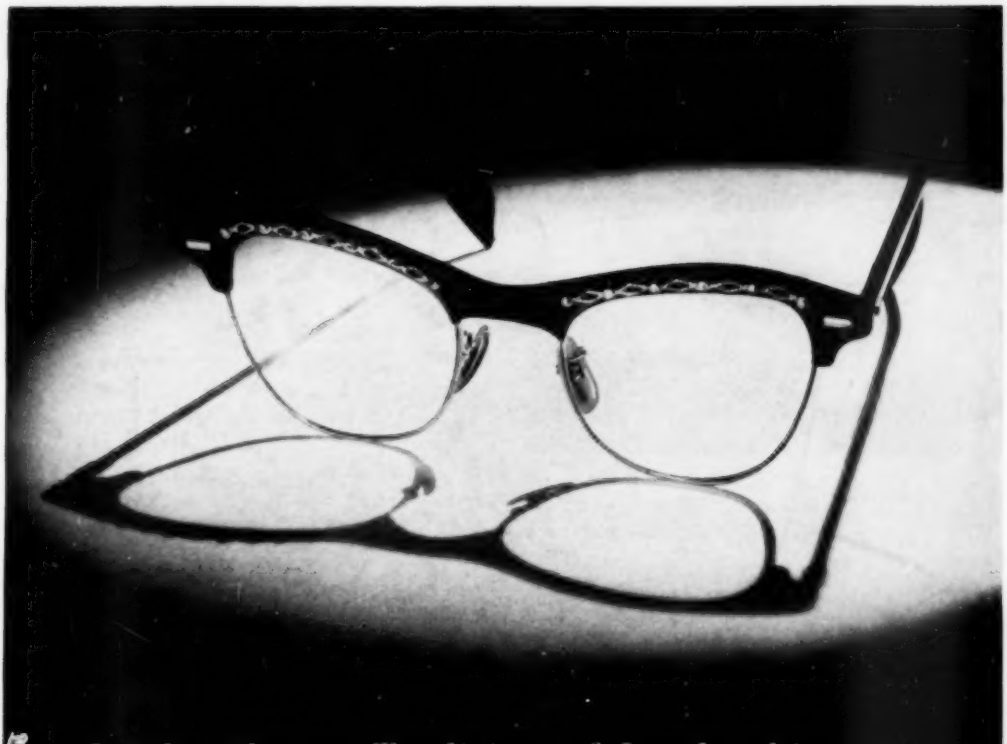

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